## **View 4** proposed (maximum parameter)

To achieve the optimum viewing distance of between 300-500mm (as per The Landscape Institute's guidelines), we recommend printing this image edge to edge on A2 landscape and viewing it from a distance of 306mm. Please refer to section 2.8 on page 5 of this document for further information.

## **View 4** proposed (minimum and maximum parameter)

To achieve the optimum viewing distance of between 300-500mm (as per The Landscape Institute's guidelines), we recommend printing this image edge to edge on A2 landscape and viewing it from a distance of 306mm. Please refer to section 2.8 on page 5 of this document for further information.

# **View 5** existing Middleton Road on roadside verge to gated entrance to bridle path

Single frame image | Lens 24.278mm | Camera height above survey point 1600mm | Nominal lens rise 0mm | Date 11.11.14 | Time 13:01

## **View 5** proposed (minimum parameter)

To achieve the optimum viewing distance of between 300-500mm (as per The Landscape Institute's guidelines), we recommend printing this image edge to edge on A2 landscape and viewing it from a distance of 306mm. Please refer to section 2.8 on page 5 of this document for further information.

## **View 5** proposed (maximum parameter)

To achieve the optimum viewing distance of between 300-500mm (as per The Landscape Institute's guidelines), we recommend printing this image edge to edge on A2 landscape and viewing it from a distance of 306mm. Please refer to section 2.8 on page 5 of this document for further information.

## **View 5** proposed (minimum and maximum parameter)

To achieve the optimum viewing distance of between 300-500mm (as per The Landscape Institute's guidelines), we recommend printing this image edge to edge on A2 landscape and viewing it from a distance of 306mm. Please refer to section 2.8 on page 5 of this document for further information.

# **View 6** existing From bridleway south of Crowmarsh Farm

Single frame image | Lens 24.278mm | Camera height above survey point 1600mm | Nominal lens rise 0mm | Date 11.11.14 | Time 13:32

## **View 6** proposed (minimum parameter)

To achieve the optimum viewing distance of between 300-500mm (as per The Landscape Institute's guidelines), we recommend printing this image edge to edge on A2 landscape and viewing it from a distance of 306mm. Please refer to section 2.8 on page 5 of this document for further information.

## **View 6** proposed (maximum parameter)

To achieve the optimum viewing distance of between 300-500mm (as per The Landscape Institute's guidelines), we recommend printing this image edge to edge on A2 landscape and viewing it from a distance of 306mm. Please refer to section 2.8 on page 5 of this document for further information.

## **View 6** proposed (minimum and maximum parameter)

To achieve the optimum viewing distance of between 300-500mm (as per The Landscape Institute's guidelines), we recommend printing this image edge to edge on A2 landscape and viewing it from a distance of 306mm. Please refer to section 2.8 on page 5 of this document for further information.

# **View 7** existing From bridleway/Aldershot Farm track to gated entrance of the field

Single frame image | Lens 24.278mm | Camera height above survey point 1600mm | Nominal lens rise 0mm | Date 11.11.14 | Time 14:05

## **View 7** proposed (minimum parameter)

To achieve the optimum viewing distance of between 300-500mm (as per The Landscape Institute's guidelines), we recommend printing this image edge to edge on A2 landscape and viewing it from a distance of 306mm. Please refer to section 2.8 on page 5 of this document for further information.

## **View 7** proposed (maximum parameter)

To achieve the optimum viewing distance of between 300-500mm (as per The Landscape Institute's guidelines), we recommend printing this image edge to edge on A2 landscape and viewing it from a distance of 306mm. Please refer to section 2.8 on page 5 of this document for further information.

## **View 7** proposed (minimum and maximum parameter)

To achieve the optimum viewing distance of between 300-500mm (as per The Landscape Institute's guidelines), we recommend printing this image edge to edge on A2 landscape and viewing it from a distance of 306mm. Please refer to section 2.8 on page 5 of this document for further information.

# APPENDIX 7.1:
# NOTE OF PHASE 1 HABITAT SURVEY OF HIMLEY FARM

**Note of Phase 1 Survey of Himley Farm**

29 October 2014

Gary Grant FCIEEM

*Introduction*

The purpose of this survey was to verify and update earlier surveys and descriptions undertaken by Hyder Consulting (UK) Ltd and Arup in 2010 and 2011. The timing of the survey was not ideal for the purposes of compiling a comprehensive list of species, with the likelihood that plants which flourish early in the year being overlooked, however the timing of the visit was satisfactory for the mapping and description of habitats.

Previous surveys indicated that the farm was arable, with most fields delineated by hedges. Recently, fields have been re-seeded as grass, which may be classified as improved grassland. In addition to the hedges and fields, Himley Farm includes strips of recently planted native broad-leaved plantations and two ponds. The various habitats are described below and a list of species noted is appended. See the attached habitat map for the distribution of habitats and location of features.

*Arable*

A single field, at the south-eastern corner of the site is still being used to grow crops. All other fields have been recently (at some point since 2011) re-seeded as improved grassland.

*Improved Grassland*

Improved grassland is the pre-dominant habitat on site. The sward is dominated by perennial rye grass *Lolium perenne* with frequent cocksfoot *Dactylis glomerata* and white clover *Trifolium repens*. Red fescue *Festuca rubra*, common bent *Agrostis capillaris* and smooth meadow grass *Poa pratensis* were also noted. Other species in the sward include greater plantain *Plantago major*, buttercup *Ranunuculs repens*, curled dock *Rumex crispus* and broad leaved dock *R. obtusifolius*,. In many places the sward is disturbed and there are patches of ruderal species including nettle *Urtica dioicia*, smooth sow thistle *Sonchus oleraceus* and scented mayweed *Tripleurospermum odoratum*, amongst others.

Improved grassland field and hedge

*Hedges*

The hedges delineate most of the fields. They are currently unmanaged, apart from the hedges, which mark the northern boundary of the farm. The hedges are dominated by blackthorn *Prunus spinosa* and hawthorn *Crataegus monogyna*, however other species of tree and shrub occur, including elm *Ulmus sp.*, crab apple *Malus sylvestris*, dogwood *Cornus sanguinea*, wayfaring tree *Viburnum lantana*, elder *Sambucus nigra* and buckthorn *Rhamnus cathartica*. Other species noted in the hedges include field rose Rosa arvensis, bramble *Rubus fructicosus agg*.,false oat-grass *Arrthenaherum elatius*, common nettle. Other species noted includes honeysuckle *Lonicera periclymenum* and ivy *Hedera helix.* There are occasional trees in the hedgerow including ash *Fraxinus excelsior* and pedunculate oak *Quercus robur*.

Native Broadleaved Plantation Woodland

The eastern edge of the farm is marked by recent (perhaps 20 years old) belts of native broad-leaved plantation woodland. Species noted include birch *Betula pendula*, ash, hazel *Corylus avellana*, field maple *Acer campestre* and cherry *Prunus avium*. Ground flora includes cleavers *Galium aparine*, common nettle, false oat grass, cock's-foot grass, amongst others.

Recent native broadleaved plantation woodland

Ponds

There are two ponds on site, one in the north known as Spring Pond and a second larger pond by a hedge to the south known as Big Pond.

Spring Pond (T1 on the habitat map) is a roughly circular pond covering about 50m$^2$. Marginal vegetation occurring in the pond includes water mint *Mentha aquatica* and branched bur-reed *Sparganium erectum*. The upper slopes of the pond were dominated by great willowherb *Epilobium hirsutum* and rough grassland dominated by cock's foot and false oat grass.


Spring Pond (T1)

The southern, Big Pond (T3 on the habitat map) covers approximately 100m2, including an island in the middle. Adjacent spoil suggest that this pond has been deepened or extended in recent years. Marginal aquatic vegetation includes water mint and yellow flag *Iris pseudocorus*. The upper banks were dominated by common nettle, great willowherb, bramble and goat willow *Salix caprea*. Soft rush *Juncus effusus* was also noted. A crack-willow tree *Salix fragilis* grows by the pond.


Big Pond (T3)

*Other*

Mature oak trees growing in the field to the east of the farmhouse (T2). A single veteran oak tree grows on the southern boundary of the site (see T4 on habitat map)
There is also a farmhouse, agricultural buildings, tracks, yards and gardens associated with a dwelling within the application site

Oak trees amidst improved grassland (T2)

**Table: Species noted at Himley Farm, October 2014**

| Scientific name | Common name | DAFOR |
|---|---|---|
| *Acer pseudoplatanus* | Sycamore | R |
| *Achillea millefolium* | Yarrow | LF |
| *Anagallis arvensis* | Scarlet pimpernel | R |
| *Arctium lappa* | Greater burdock | R |
| *Arrhenatherum elatius* | False oat grass | F |
| *Agrostis stolonifera* | Creeping bent | O |
| *Anthriscus sylvestris* | Cow parsley | O |
| *Artemisia vulgaris* | Mugwort | O |
| *Arum maculatum* | Lords and ladies | O |
| *Bellis perennis* | Common daisy | LA |
| *Betula pendula* | Silver birch | O |
| *Bryonia dioicia* | White bryony | O |
| *Capsella bursa-pastoris* | Shepherd's-purse | O |
| *Chamnaenerion angustifolia* | Rosebay willowherb | O |
| *Chenopodium album* | Fat hen | R |
| *Cirsium arvense* | Creeping thistle | LF |
| *Cirsium vulgare* | Spear thistle | R |
| *Convolvulus arvensis* | Field bindweed | O |
| *Cornus sanguinea* | Dogwood | O |
| *Crataegus monogyna* | Hawthorn | LD |
| *Dactyls glomerata* | Cocksfoot | F |
| *Deschapsia cespitosa* | Tufted hair grass | R |
| *Elytrigia repens* | Couch grass | O |
| *Epilobium adenocaulon* | American willowherb | R |
| *Epilobium hirsutum* | Great willowherb | LD |
| *Festuca rubra* | Red fescue | O |
| *Fraxinus excelsior* | Ash | F |
| *Galium aparine* | Cleavers | LF |
| *Geranium robertianum* | Herb robert | R |

| | | |
|---|---|---|
| *Geum urbanum* | Wood avens | O |
| *Hedera helix* | Ivy | LD |
| *Heracleum spondylium* | Hogweed | O |
| *Holcus lanatus* | Yorkshire fog | O |
| *Iris pseudocorus* | Yellow flag | R |
| *Juncus effusus* | Soft rush | O |
| *Lamium album* | White dead-nettle | R |
| *Lamium purpureum* | Red dead nettle | R |
| *Lolium perenne* | Perennial rye grass | D |
| *Lonicera periclymenum* | Honeysuckle | O |
| *Malus sylvestris* | Crab apple | O |
| *Matricaria discoidea* | Pineapple weed | O |
| *Medicago lupulina* | Black medick | R |
| *Myosotis arvensis* | Field forget me not | R |
| *Papaver rhoeas* | Common poppy | R |
| *Plantago lanceolata* | Ribwort plantain | A |
| *Poa annua* | Annual meadow-grass | O |
| *Prunella vulgaris* | Selfheal | R |
| *Prunus avium* | Cherry | O |
| *Prunus spinosa* | Blackthorn | LD |
| *Quercus robur* | Common oak | O |
| *Ranunculus repens* | Creeping buttercup | O |
| *Rhamnus cathartica* | Buckthorn | O |
| *Rosa canina* | Field rose | O |
| *Rubus fructicosus* | Bramble | LD |
| *Rumex crispus* | Curled dock | O |
| *Rumex obtusifolius* | Broad leaved dock | F |
| *Salix caprea* | Goat willow | O |
| *Salix fragilis* | Crack willow | R |
| *Sambucus nigra* | Elder | O |
| *Sisymbrium officinale* | Hedge mustard | O |
| *Solanum dulcamara* | Bittersweet | R |
| *Sonchus asper* | Prickly sow thistle | O |
| *Sonchus oleraceus* | Smooth sow thistle | O |
| *Stellaria media* | Chickweed | R |
| *Taraxacum officinale agg* | Dandelion | F |
| *Tripleurospermum odoratum* | Scented mayweed | R |
| *Typha latifolia* | Reedmace | LD |
| *Trifolium pratense* | Red clover | O |
| *Trifolium repens* | White clover | A |
| *Urtica dioica* | Nettle | LD |
| *Viburnum lantana* | Wayfaring tree | O |

D = Dominant
A = Abundant
F = Frequent
O = Occasional
R = Rare

L = Locally

# APPENDIX 7.2:
# NW BICESTER ECO DEVELOPMENT:
# TECHNICAL APPENDIX 6A TO 6I

# a2dominion

# North West Bicester Eco development

## Technical Appendix 6A to 6I

### Ecology Surveys

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# North West Bicester Development

## Technical Appendix 6A to 6I

## Ecology Surveys

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**Approver** Philip Harker

**Report No** 0550-UA005241-UE21-R02EcoTA Final

**Date** February 2014

# CONTENTS

Drawings that accompany the Appendices

Drawing 6-1 Phase 1 habitat survey

Drawing 6-2 Pond, grassland, woodland and hedgerow locations

Drawing 6-3 Badger setts, bat roosts and key activity corridors

# 1 SUMMARY

1.1.1.1 In 2010, 2011 and 2013 ecological surveys were undertaken to inform the Masterplan for the NW Bicester Eco development site. The results of these surveys inform an ecological impact assessment that is part of the Environmental Statement that accompanies the planning application for the Eco development on the Masterplan site.

1.1.1.2 The baseline surveys that were undertaken comprise the following:

- Phase 1 Habitat Survey, hedgerow assessment and protected species walkover surveys;
- Botanical survey of the grasslands and woodland using National Vegetation Classification;
- Aquatic invertebrate surveys, including those to confirm the presence/absence of white-clawed crayfish;
- Surveys for terrestrial invertebrates, including targeted surveys for barberry carpet moth and brown hairstreak butterflies;
- Surveys for great crested newts within the Eco development site and the wider environs;
- Surveys to confirm the presence/absence of reptiles;
- Surveys for breeding birds, including barn owls;
- Surveys for over-wintering birds;
- Bat activity surveys;
- Surveys to confirm the presence/absence of roosting bats;
- Surveys to confirm the presence/absence of dormice, water voles and otters;
- Badger surveys;
- Incidental sightings of other protected/ notable species during targeted surveys identified above;
- Ground-truthing surveys to confirm the status of the known ecological constraints in 2011 and 2013; and
- Surveys to assess water quality within the River Bure.

1.1.1.3 These surveys revealed that the Masterplan site largely comprised cultivated arable farmland with a small number of grassland fields supporting improved grassland. Most of the boundary hedgerows were species-rich with a few supporting mature trees. Most of the hedgerows would be classified as ‘important’ under the Hedgerows Regulations (1997) on the basis of their floral composition and the fact that they contain features of value as recognised by these regulations. The hedgerows were not found to support dormice and it is considered that they are absent from the Masterplan site.

1.1.1.4 A small number of ponds were present in the Masterplan site. Two ponds within the southern half of the site supported a ‘medium’ population of great crested newts. Other ponds that were found to support great crested newts were located a sufficient distance from the Masterplan site boundary, that any newts using these features would not be expected to regularly forage within the Masterplan site.

1.1.1.5 A small number of ditches and watercourses were present within the Masterplan site. Water levels within these features have been found to fluctuate. Most of the hedgerow ditches were heavily shaded by the hedgerows and devoid of water for most, if not all, of the year. Three watercourses cross the site: the River Bure and its tributaries. The River Bure flows in a north to south direction starting at a point close to Home Farm and leaving the site via a culvert beneath Lord's Lane (the road that forms the eastern boundary to the Masterplan site). One tributary commences near the pond at Crowmarsh Farm (large pond south of the railway line and on the western boundary of the Masterplan site) and flows in an easterly direction towards Lord's Lane where it meets the River Bure. The other commences in Bucknell and joins the River Bure a few hundred metres south-west of Home Farm. The tributaries were not found to support water throughout the summer months. The water in the River Bure was of 'moderate' quality and found to support common and widespread aquatic invertebrates. These watercourses were not found to support native crayfish nor water voles. Otters may occasionally travel along these features whilst accessing other parts of their home range; but no confirmatory signs of otter activity were recorded during the surveys.

1.1.1.6 The Masterplan site as a whole was found to support a suite of common terrestrial invertebrate species. However, ten species recognised as being of Principal Importance on the Natural Environment and Rural Communities Act (2006) were recorded, including nine moth species and the brown hairstreak butterfly. The brown hairstreak was found to be associated with the hedgerows that supported Blackthorn; with hedgerow and/or woodland edge trees also a necessary part of their lifecycle. Most of the moths were associated with the more overgrown and 'weedy' habitats associated with the derelict buildings of Gowell Farm, with a reasonable number (five species) associated with the tree and shrub-lined lane leading to Lord's Farm. Another species of conservation concern, the white-letter hairstreak, has been found in hedgerows on land to the south of the Masterplan site. It is likely that this species may also be associated with the hedgerows that support elm that are within the Masterplan site.

1.1.1.7 Five Nationally Scarce invertebrates were recorded within the Masterplan site (one species is now considered to be Nationally Local and no longer scarce). One of these species was associated with the Exemplar site, two associated with Gowell Farm and one with the tree and shrub-lined lane to Lord's Farm. Twenty Nationally Local invertebrate species were also recorded within the Masterplan site, the parts of the site that supported the largest numbers of these species were the habitats around Gowell Farm and the lane to Lord's Farm. Although a small number of Barberry shrubs were recorded in the hedgerows, the rare moth associated with this plant, the barberry carpet, was not found to be present.

1.1.1.8 Common lizards were recorded in the field margins and it is considered likely that grass snakes may also be present, particularly in association with the watercourses and ponds.

1.1.1.9 Common pipistrelle bats have been recorded roosting in a number of the trees and buildings across the site (a total of four roosts have been confirmed within the Masterplan site with a further three confirmed roosts beyond the site boundary). Pipistrelle bats were also regularly recorded foraging and commuting across the site in association with the watercourses and hedgerows. Other bats regularly recorded commuting and foraging across the site, also in association with the hedgerows and stream corridors, included noctule, Leisler's, soprano pipistrelle and *Myotis* bats.

1.1.1.10 The Masterplan site as a whole was found to support farmland birds in reasonable numbers during the breeding season, including species of conservation concern, such as skylark, linnet, yellowhammer and song thrush. Large flocks of these birds were also recorded overwintering in stubble fields and in association with the hedgerows. The locations of the wintering flocks will be subject to change dependent on the crop rotation; crop rotations will also affect the distribution of breeding birds, but to a lesser extent. Barn owl were recorded nesting in a box,

this box together with two new boxes were relocated to the edge of the Masterplan site as part of the mitigation measures for the consented Eco development.

1.1.1.11 [redacted]

# 2 Introduction

2.1.1.1 This report presents the baseline conditions with respect to ecology for the NW Bicester Eco development site. It presents the results of targeted ecological surveys that were undertaken by Arup and Hyder Consulting UK Limited (Hyder) to provide a baseline for an ecological impact assessment. It should be noted that at the time of the Arup surveys, the red line development boundary had not been finalised, and therefore, their surveys covered a far wider area than would be affected by the Masterplan; this included land 650 metres (m) to the west (see Drawing 6-1). At the time of the Arup surveys, access was not available to a parcel of land within the southern part of the Masterplan site, associated with Himley Farm; this area was subsequently surveyed by Hyder. Both Hyder and Arup undertook targeted surveys for particular target species or groups as listed in Table 2-1 (below). The extent of the Masterplan site is illustrated by the red boundary on Drawing 6-1. The Masterplan site also includes the part of the site that has planning consent for an Eco development known as the Exemplar site. The Exemplar site was also subject to a number of targeted surveys and the results of these surveys have been incorporated into this report where appropriate.

2.1.1.2 Table 2-1 (below) identifies the surveys that were undertaken by both Arup and/or Hyder and the dates of survey. More detail regarding the methodologies adopted can be found in Section 4 of this report. It should be noted that all surveys were undertaken by suitably experienced, and where necessary, licenced ecologists that were either employees of the respective consultancies, or specialist sub-consultants. All surveys followed the best practice guidance that was in effect at the time of the surveys (see limitations to surveys in Section 5 of this report for more details).

Table 2-1: Summary of ecological baseline surveys

| Survey (including target species/group as appropriate) | Consultant | Date |
|---|---|---|
| Phase 1 Habitat Survey | Arup | Spring 2010 |
| Phase 1 Habitat Survey, hedgerow assessment and protected species walkover survey of land where access was previously denied | Hyder | 1st and 2nd September 2010 |
| Botanical survey of grasslands and woodland using the National Vegetation Classification (NVC) | Arup | 28th and 30th July 2010 |
| Hedgerow assessment | Arup | July 2010 |
| Aquatic invertebrate surveys including surveys to confirm the presence/absence of white-clawed crayfish (*Austropotamobius pallipes*) | Arup | 5th August and 15th September 2010 |
| Surveys for aquatic invertebrates | Arup | 21st October 2010 |
| Aquatic invertebrate survey to provide a pre-construction baseline for the Exemplar site (the Exemplar site is in the northern part of the Masterplan site) | Hyder | 26th October 2012 |
| Surveys for terrestrial invertebrates | Arup | 3rd July and 21st October 2010 |

| Survey (including target species/group as appropriate) | Consultant | Date |
|---|---|---|
| Surveys to confirm the presence/absence of barberry carpet moth (*Pareulype berberata*) | Hyder + licenced sub-consultant | 27th July and 13th September 2011 |
| Surveys to confirm the presence/absence of brown hairstreak (*Thecla betulae*) butterflies | Hyder | 18th February 2011 |
| Surveys for great crested newts (*Triturus cristatus*) within the Eco development site and the wider environs | Arup | 10th - 12th, 17th, 18th, 24th - 27th May; 1st - 3rd, 8th - 11th June 2010 |
| Surveys for great crested newts within land where access was previously denied | Hyder | 12th, 13th, 26th and 27th April and 17th and 18th May 2011 |
| Surveys to confirm the presence/absence of reptiles | Arup | July to October 2010 ( 1st July; 26th, 27th Aug; 21st, 22nd, 23rd, 28th,29th Sept; 5th, 7th, 13th, 19th, 20th Oct) |
| Surveys for breeding birds including barn owls (*Tyto alba*) | Arup | 25th May to 29th July 2010 |
| Surveys for breeding birds within land where access was previously denied | Hyder | 12th April, 6th May and 24th June 2011 |
| Surveys for over-wintering birds | Hyder | 12th – 14th January, 1st – 4th February and 7th – 9th March 2011 |
| Bat activity surveys | Arup | 18th May; 10th, 23rd, 24th, 30th June; 7th, July 1st, 5th, 6th, July 2010 |
| Bat activity survey of land where access was previously denied | Hyder | 27th and 28th July and 14th September 2011 |
| Surveys to confirm the presence/absence of roosting bats | Arup | 17th May to 23rd September 2010 |
| Surveys to confirm the presence/absence of roosting bats within buildings, where access was previously denied | Hyder | 27th and 28th July and 14th September 2011 |

| Survey (including target species/group as appropriate) | Consultant | Date |
|---|---|---|
| Surveys to confirm the presence/ absence of dormice (*Muscardinus avellanarius*) | Arup | June to October 2010 |
| Surveys to confirm the presence/ absence of water voles (*Arvicola amphibius)* | Arup | 7th and 16th June; and 28th August 2010 |
| Surveys to confirm the presence/ absence of otters (*Lutra lutra*) | Arup | 7th and 16th June; and 28th August 2010 |
| Badger survey | Arup | 10th May, 7th, 14th, 15th October 2010 |
| Badger (*Meles meles*) bait marking study | Arup | May 2010 |
| Incidental sightings of other protected/ notable species during targeted surveys identified above (brown hare (*Lepus europaeus*)) | Arup and Hyder | Throughout 2010 and 2011 surveys |
| Ground-truthing surveys to confirm the status of the known ecological constraints | Hyder | March 2011<br>October 2013 |

# 3 Study area

3.1.1.1 The survey area that was adopted by Arup comprised the Masterplan site and the fields immediately adjacent (to the west, extending up to 650 m). It is understood that this extra area was surveyed as the extent of the final Masterplan had not been determined at the time. For great crested newts, the survey area was increased to include waterbodies that were within 500m of the extended Masterplan site boundary. For bats, the survey area was extended to include St Laurence Church, Caversfield, which is north of the B4100 and a known roost site for bats. The desk study extended up to approximately 5 km from the centre of the Masterplan site in order to identify records of protected species, species of conservation concern and non-statutory designated sites of nature conservation importance. A wider area of search up to 10 km was adopted to identify statutory designated sites of nature conservation importance, as requested by Natural England in response to the Scoping report that was produced for the Exemplar site development.

# 4 Methodologies

## 4.1 Desk study

The desk study was conducted within a 10 km radius of the central grid reference for the site focused on statutory designated sites of nature conservation importance. This involved a web based search, using Nature on the Map (Ref 6-1) and the Multi-Agency Geographic Information for the Countryside website (MAGIC) (Ref 6-2). In addition, data regarding distributions of notable and protected species and non-statutory designated sites of nature conservation importance was obtained from the Thames Valley Environmental Records Centre (TVERC) within a 5 km radius of the Masterplan site. Records for a 2 km search area were also obtained from other specialist groups, including: the Banbury Ornithological Society (BOS); the Barn Owl Conservation Network (BOCN); and the Oxfordshire Ornithological Society (OOS). The Butterfly

Records Officer for the Upper Thames Branch of Butterfly Conservation was contacted for all records of butterflies within the 12, 1 km grid squares within and surrounding the Masterplan site. These records were provided for the years 1995 and 2010 and information regarding the local conservation status of any butterflies of concern recorded was also provided.

4.1.1.1 Further information on brown hairstreak butterflies was obtained from the Brown Hairstreak Species Champion within the Upper Thames Branch of Butterfly Conservation, including recent survey data from 2011 within and surrounding the proposed development. The County Moth Recorder was contacted for information regarding moth species within the local area and specifically for further information on the likely presence of barberry carpet within the area.

4.1.1.2 The Local Biodiversity Action Plan (BAP) for Cherwell (Ref 6-3) was consulted for details of species of note that could be expected to occur in the area. The list of habitats and species of Principal Importance identified on Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 (Ref 6-4) was also reviewed with regard to the habitats and species recorded as present or likely to be present within the Masterplan site.

## 4.2 Phase 1 habitat survey (Arup surveys)

4.2.1.1 The field survey followed standard methodology as described in the Handbook for Phase 1 Habitat Survey (Joint Nature Conservation Committee (JNCC), 2010) (Ref 6-5). The extent of each area of homogenous vegetation was mapped in the field, noting the dominant vegetation communities present, in order to produce a Phase 1 Habitat Map of the site. Evidence of protected species, or the potential to support protected species, was also noted. Based on the habitats present, at and around the site, and on professional judgement informed by the findings of the desk study, the protected and notable species most likely to be present at the site were considered to be amphibians, reptiles, badger, brown hare, white-clawed crayfish, bats, dormice, water voles, otters and birds. Therefore searches for signs of these species, including footprints, scratch marks, feeding stations, burrows, setts, spraint, droppings, foraging signs, staining, nesting or roosting places were searched for at the time of the survey. Any man-made or natural refugia were inspected and, where possible, lifted to search for sheltering wildlife such as reptiles and amphibians.

## 4.3 Phase 1 habitat survey and protected species walkover survey (Hyder surveys)

4.3.1.1 As described in the introduction, at the time of the Arup surveys, access was not available to a parcel of land within the southern part of the Masterplan site, associated with Himley Farm. A multi-disciplinary walkover survey was undertaken of this part of the site which comprised a Phase 1 habitat survey and protected species walkover survey.

4.3.1.2 The habitat survey involved identifying and mapping the dominant habitat types following the Phase 1 habitat survey methodology recommended by JNCC (Ref 6-5). Dominant plant species were noted, as were any uncommon species or species indicative of particular habitat types, but no attempt was made to compile exhaustive species lists. Botanical names followed Stace (1997) (Ref 6-6).

4.3.1.3 The status of each hedge with regard to the Hedgerows Regulations (1997) (Ref 6-7) was assessed using the Wildlife and Landscape Criteria. Every hedgerow within this area that was within agricultural/horticultural land use was surveyed. This involved collecting information as described in Section 4.5 (below).

4.3.1.4 The protected species survey involved a critical assessment of the value of terrestrial and aquatic habitats suitable for use by protected species or species of conservation concern. The methodologies adopted were as follows:

- An assessment was made of the water bodies present on site, for their potential to support breeding amphibians, including great crested newts. Each pond was subject to a Habitat Suitability Index (HSI) Assessment (Ref 6-8). In addition, the value of terrestrial habitat on site for use by foraging and hibernating amphibians was assessed;
- The value of the site for roosting and foraging bats was assessed, and all the mature trees and other structures were carefully scrutinised from the ground using binoculars, where appropriate, to assess their likely occupancy by roosting or hibernating bats;
- The value of the habitats within and adjacent to the site for breeding and over-wintering birds was critically assessed;
- The hedgerows and any areas of dense scrub/broad-leaved plantation, were assessed for their suitability for use by dormice;
- Areas of rough grassland and scrub within and adjacent to the site were assessed for their suitability for reptiles;
- The site was investigated for its use by badgers by searching for the characteristic signs of badger activity including setts, latrines, paths, footprints, hairs and feeding signs. The survey area was extended to the west to search adjacent areas for badger setts; and
- The value of the site for other protected species or groups was also critically assessed. This included an assessment of the value of the site for invertebrates, birds, water voles and otters.

## 4.4 NVC survey

4.4.1.1 Arup's Phase 1 Habitat Survey identified areas of neutral grassland and broad-leaved woodland as potential habitats of Principal Importance under Section 41 habitats of the NERC Act. A survey was undertaken to assess the value of these habitats in more detail.

4.4.1.2 The field survey involved identifying plants and sampling vegetation in accordance with the NVC methodology (Ref 6-9 and 6-10). This was undertaken between 28th July and 6th August 2010. Within the Masterplan site, three areas of grassland west of Home Farm alongside the watercourse were sampled and one area of grassland south-west of Hawkwell Farm (also alongside the watercourse) was sampled (locations shown on Drawing 6-2). Each field was sampled using five 2m x 2m quadrats. Within each quadrat, the relative plant cover of each species was recorded by eye using the DOMIN scale (Ref 6-10). Other details of the sampled vegetation were also recorded: stand area, sample area, vegetation layer cover and mean height, slope, aspect, altitude and soil description.

4.4.1.3 Three blocks of semi-natural broad-leaved woodland were also subject to NVC survey. These comprised the two woodland blocks west of Home Farm and the block of woodland south of Hawkwell Farm (as illustrated on Drawing 6-2). Five quadrats were used to sample an area of homogeneous vegetation within the woodland (five quadrats in the woodlands in Home Farm and five in the woodland south of Hawkwell Farm). Each quadrat comprised a selected canopy area, within which quadrats were located to sample the plants within understorey, field layer and ground layer area. The quadrat dimensions were:

- 50 m × 50 m for the canopy;

- 10 m × 10 m for the understorey;
- 4 m × 4 m for the field layer; and,
- 1 m × 1 m for the ground layer.

4.4.1.4 Within each quadrat, the relative plant cover of each species was assessed by eye and then assigned a score according to the DOMIN scale (Ref 6-9).Other details of the sampled vegetation were also recorded: stand area, sample area, vegetation layer cover and mean height, slope, aspect, altitude and soil description. The grasslands and woodlands that were subject to survey are illustrated on Drawing 6-2.

## 4.5 Hedgerow assessment

4.5.1.1 Following Arup's Phase 1 Habitat Survey, which identified a network of diverse and relatively species-rich hedgerows across the site, a hedgerow survey of the Masterplan site was undertaken in July 2010.

4.5.1.2 The selection criteria for hedgerows for further assessment were determined with consideration to any potential impacts to the hedgerows on a landscape scale. The Phase 1 Habitat Survey identified those hedgerows requiring further survey based on the diversity of the hedgerow and the following criteria:

- Hedgerows abutting and/or adjacent to watercourses;
- Hedgerows parallel to and within 15m of a watercourse;
- Hedgerows abutting and/or adjacent to woodland;
- Hedgerows adjacent to a public bridleway.

4.5.1.3 A field survey was undertaken which followed the Local Hedgerow Survey methodology as detailed in the Hedgerow Survey Handbook (Ref 6-11). This survey collects data to inform the determination of hedgerow importance as detailed in the Hedgerows Regulations 1997. The Hedgerows Regulations 1997 outline the criteria for determining "important" hedgerows. These criteria include archaeological and historical criteria as well as ecological criteria.

- The length of each hedgerow was calculated prior to the survey from Ordnance Survey 1:2,500 maps;
- For every 100m of hedge the central 30m section was surveyed, with a maximum of three 30m sections per hedgerow;
- In each 30m section, the presence of woody (tree and shrub) species and woodland (herbaceous) species within one metre, in any direction, of the outermost edges of the hedgerow was recorded;
- For the whole hedgerow, the number of standard (mature) trees was recorded;
- Other data gathered for the whole hedgerow included hedge height, width, structure, management, information on ditches and banks associated with the hedge, whether gaps formed less than 10% of the hedge and adjacent land use and connections.

4.5.1.4 A further assessment was made on site to permit the categorisation of each hedgerow using the Hedgerow Evaluation and Grading System (HEGS) (Ref 6-12). This method allows a hedgerow

to be categorised according to its significance to wildlife. Hedgerows are graded on a scale of 1-4 (high value to low value) to reflect their ecological value based on the hedgerow structure, connectivity, species diversity and associated features. To grade a hedgerow:

- The height, width, length and structure of the average cross-section of each hedgerow was assessed;
- The number, age and species of standard trees was recorded per 100m;
- Percentage gaps and the number of end connections (a value of 1 per hedgerow or other linear feature; 2 for woodland) was determined;
- A full species list was compiled of the hedge canopy and whether the hedge is native species dominant;
- Associated features such as the presence of a hedge-bank, lynchet, ditch and or grass verge were noted; and,
- A species list prepared of ground flora and notes of any notable species.

4.5.1.5 In addition, notable plant species (species of nature conservation importance) were identified during the survey if they were:

- Section 41 (NERC Act) species;
- Afforded legal protection by being listed on Schedule 8 of the Wildlife and Countryside Act 1981 (as amended); and/or,
- Listed as Critically Endangered, Endangered, Vulnerable or Near Threatened in the Vascular Plant Red Data List for Great Britain (Ref 6-13).

## 4.6 Aquatic invertebrate survey

### Crayfish survey

4.6.1.1 Targeted crayfish surveys were undertaken during August and September 2010. The field survey comprised a habitat survey to assess the suitability of the watercourses for white-clawed crayfish, which was undertaken on 5th August and based on habitat descriptions in relevant guidance documents (Ref 6-14 and 6-15). The following information was recorded:

- Water clarity;
- Bed substrate and materials suitable for refuge;
- Potential food supply;
- Siltation;
- Observed presence of crayfish and fish;
- Any negative indicators e.g. pollution inputs.

4.6.1.2 These details were also recorded during the subsequent trapping and torchlight surveys to ensure that any changes were identified.

4.6.1.3 Following the initial habitat survey, a manual survey, trapping survey and torchlight survey were carried out. The manual survey was undertaken on the 5th August 2010. In accordance with the principles of Peay (Ref 6-15) the methodology involved selecting four habitat patches over a 200m section, with 50 suitable stones turned within each habitat patch. However, in-channel refugia were limited and suitable stones were turned where present.

4.6.1.4 A trapping survey was undertaken over two days, with traps set on the afternoon of 15th September 2010 and checked and removed on the following morning. The habitat suitability assessment identified the pond at Crowmarsh Farm (location shown on Drawing 6-2, hereafter known as Crowmarsh pond) as the only suitable habitat for crayfish that had adequate depth to allow a trapping survey. TRAPPY pyramid traps, which met the standard Environment Agency requirements, were used. The traps were baited with cat food and tagged with the Environment Agency CR1 licence tags. In total, ten traps were deployed around the margin of the pond.

4.6.1.5 In addition, a torchlight survey was undertaken on the evening of 15th September 2010 along the River Bure, its tributaries and in the pond at Crowmarsh pond. This method of survey involved scanning the watercourse with a high-powered torch, in order to identify any crayfish which may be moving on the bed of the watercourse/ pond.

## General surveys for aquatic invertebrates

4.6.1.6 In 2010, most of the watercourses within the Masterplan site were dry throughout the summer. Water returned to some of these features in September 2010 but flowing water was only found in the main watercourses by October 2010. Aquatic invertebrates were sampled using a hand net from three locations along the tributary of the River Bure between Crowmarsh pond and its confluence with the River Bure within the Masterplan site. Aquatic invertebrate samples were also taken from Crowmarsh pond and the stream that feeds it (most of which is outside the Masterplan site). A sample was also taken from an off-site pond in Bucknell.

4.6.1.7 Surveys for aquatic invertebrates were also undertaken in order to provide a pre-construction baseline for future monitoring during the construction for the consented Eco development on the Exemplar site. A locations plan and photographs of the sampling locations are included in the pre-construction survey report (Ref 6-16). Water samples were collected in October 2012 from three locations on the River Bure in order to establish a baseline for water quality prior to construction. All three of these sampling locations are on the Masterplan site. They comprised:

- Location 1, 60 metres downstream of the Exemplar development area (Ordnance Survey (OS) grid reference SP 57769 24730);
- Location 2 within the Exemplar development area (OS grid reference SP 57870 24884);and
- Location 3, 60 metres upstream of the Exemplar development boundary (OS grid reference SP 57970 24997).

4.6.1.8 The three sites were sampled using the standard protocol employed by the Environment Agency for sampling lotic watercourses (detailed in Environment Agency internal document No. 018_08, which has now replaced the more detailed BT001 (Ref 6-17)). This protocol involved a timed period of three minutes of active net sampling (the time being apportioned to each habitat according to the proportion of the site that it covered), accompanied by a one minute hand-search.

4.6.1.9 The net sampling was carried out using a FBA pattern pond net, fitted with a 1mm mesh collecting bag and involved a combination of kick sampling and sweeping the net through the water channel. This was accompanied by manual investigation of submerged coarse woody debris and larger stones for attached organisms (e.g. the river limpet (*Ancylus fluviatilis*)) and

searches of the water surface for surface-dwelling animals (e.g. pond skaters (*Gerris* spp.)), for a timed period of one minute in total at each site.

4.6.1.10 After collection, the samples were preserved on-site, in a solution of 90% Industrial Methylated Spirits (IMS or Denatured Ethanol B), 5% water and 5% glycerol for transportation to the laboratory and subsequent analysis.

4.6.1.11 In addition to macro-invertebrates, any fish of conservation concern incidentally observed during the surveys were also recorded.

4.6.1.12 The macro-invertebrate samples were then identified, under laboratory conditions, to species level where possible, or if this was not possible, identification was undertaken to the lowest possible taxa, using standard freshwater invertebrate sorting and identification procedures, and using industry standard identification keys.

4.6.1.13 Appropriate bio-security measures were adopted whilst undertaking all surveys within the aquatic environment, in order to avoid the inadvertent spread of crayfish plague and chytridiomycosis (a fungal disease that adversely affects amphibian populations).

## 4.7 Terrestrial invertebrate survey

4.7.1.1 The value of the Masterplan site as a whole for invertebrates was assessed as part of the Phase 1 habitat surveys. Targeted surveys were undertaken in order to assess the variety of species present. Initially, a site scoping study was undertaken on the 29th June 2010 which involved a walkover survey of the entire Masterplan site to determine the nature and extent of detailed survey work required. Subsequent visits were undertaken between 3rd July and 21st October 2010 to carry out moth recording, terrestrial sampling and aquatic sampling. These surveys were undertaken by Colin Plant, a recognised invertebrate specialist, and are described in detail in the Invertebrate Survey Report (Appendix 6F).

4.7.1.2 On all visits, terrestrial invertebrates were recorded by direct observation of both species and their signs. Active sampling was also undertaken using sweep-netting, beating trees and bushes and suction sampling. In addition, passive sampling using pitfall trapping and actinic light trapping was undertaken.

4.7.1.3 Targeted surveys for the barberry carpet moth and the brown hairstreak butterfly were also undertaken. Barberry carpet moth surveys were carried out by a specialist entomologist (Martin Townsend) following the identification of six stands of Barberry (*Berberis vulgaris*) within the Masterplan site. The presence of the larvae was surveyed using the Bignell pattern beating tray, which is held under the vegetation. The vegetation was then tapped lightly to dislodge larvae and other insects and the contents of the tray were then examined. Since the moth has two generations in a year, the Barberry bushes were sampled twice, once on the 27th July and once on the 13th September 2011. A survey for the brown hairstreak butterfly was undertaken on 18th February 2011, and involved searching for the eggs of this species on Blackthorn (*Prunus spinosa*).

## 4.8 Great crested newt survey

4.8.1.1 Surveys for great crested newts were carried out in May 2010. The survey area included the waterbodies up to 650m west of the current site boundary plus a 500m buffer zone.

4.8.1.2 A Habitat Suitability Index (HSI) assessment of all waterbodies (where access permitted) within the survey area (as above) was undertaken. The HSI scoring system (Ref 6-8) was used, which scores a water body against ten habitat suitability indices. These indices include water quality,

the likely presence/absence of fish and aquatic plant cover. From these ten suitability indices a geometric mean is calculated, which gives an overall numerical index, ranging between zero and one. A score of near zero indicates highly sub-optimal habitat whilst a score near one represents optimal habitat for use by breeding newts. However, the HSI is not a substitute for undertaking newt surveys and if a water body is awarded a high HSI score, this does not guarantee that great crested newts will be present, only that they are more likely to be present in this water body than in a sub-optimal water body. As such, HSI scores alone were not used to rule the ponds in or out from further survey. A total of 13 waterbodies were assessed in this way, and 12 were considered suitable for survey (Ponds labelled P1 to P13 on Drawing 6-2). Pond 11 was dry by late May 2010 and thus, considered unsuitable for use by breeding great crested newts in 2010. This pond is on the edge of Bucknell (475 m north- west of the Masterplan site boundary) and was not subject to further survey in subsequent years due to the distance between the pond and the Masterplan site.

4.8.1.3 Suitable waterbodies were then subject to presence/ likely absence surveys in accordance with the Great Crested Newt Mitigation Guidelines (Ref 6-18). Surveys were carried out by licenced surveyors between 10th and 25th May 2010. The waterbodies were surveyed using four of the following techniques, whichever were the most suitable at a particular waterbody:

- Bottle trapping involved setting bottle traps (comprising 2-litre plastic drinks bottles with the top end cut off and inverted inside the main body of the bottle) along the waterbody/ditch margins. These were supported in each waterbody on canes stuck into the sediment. Traps were set at two metre intervals whenever access allowed informing population size class estimates. Traps were set in the evening and checked early the following morning during each survey. All amphibians captured were identified to species level and sexed.

- Sweep netting involved using a standard pond net with 2 mm x 4 mm mesh during the day to sweep the water column and aquatic vegetation. Where possible, 15 minutes of sweeping was undertaken for each 50 metres of shoreline. Once the presence of great crested newts was confirmed, netting ceased, as the survey technique can only be used for determining presence or absence, not for producing population size class estimates.

- Egg searching involved checking marginal and aquatic vegetation around the ponds for great crested newt (and other newt species') eggs. Newts often wrap their eggs in the leaves of vegetation around the margins of ponds. Great crested newt eggs can be relatively easily distinguished from smooth or palmate newt (*Lissotriton vulgaris* or *L. helveticus*) eggs by their larger size and different colouration. Once great crested newt eggs were found in any pond, no further egg searches were undertaken, as the survey technique can only be used for determining presence or absence, not for producing population size class estimates.

- Torchlight surveys comprised a single walk around the waterbodies at night at a measured pace using a bright torch to locate and identify amphibians. During the survey all animals observed were counted, sexed and identified to species where possible.

- Refuge searching involved checking natural and artificial refugia around the waterbodies for the presence of newts. Refugia include logs, debris, bark, moss, stones/rocks etc. This is usually most effective as an additional method, to supplement other surveys such as bottle trapping.

4.8.1.4 Four survey visits were undertaken to each waterbody; where great crested newts were recorded, a further two visits were undertaken to make six in total.

4.8.1.5 Due to access restrictions during 2010, Arup were unable to carry out surveys of ponds within a parcel of land associated with Himley Farm. The walkover survey of this land undertaken by Hyder revealed the presence of two ponds (labelled P14 and P15 on Drawing 6-2) both potentially suitable for use by breeding amphibians. As such, great crested newt surveys of these ponds were undertaken on the following dates: 12th, 13th, 26th and 27th April and 17th and 18th May 2011 in accordance with the field survey methodology described above. .

4.8.1.6 Appropriate bio-security measures were adopted whilst undertaking the surveys, in order to avoid the inadvertent spread of waterbourne diseases such as chytridiomycosis and crayfish plague. Although surveys were targeted to establish the presence/absence of great crested newts the presence of other amphibians was also recorded incidentally during the surveys.

## 4.9 Reptile survey

4.9.1.1 The Phase 1 habitat surveys identified habitat suitable for supporting reptiles. The criteria for habitat suitability followed the guidance from the National Amphibian and Reptile Recording Scheme (Ref 6-19) and the Herpetofauna workers' manual (Ref 6-20). The following features were considered suitable:

- Variable vegetation structure;
- Extent of habitat large enough to support a population of reptiles;
- The aspect offers sunny, sheltered locations preferably south-facing;
- Natural and/or artificial refugia;
- Variable undulating topography;
- Connectivity between suitable habitat patches;
- Historic land-use of the site.

4.9.1.2 Suitable habitats were identified including areas of scrub, woodland with glades, hedgerow banks, partially vegetated embankments, semi-improved grassland, vegetated watercourses and the unmanaged habitats associated with Gowell Farm. Reptiles also need areas for egg laying sites and refugia such as log-piles, compost heaps and rubble.

4.9.1.3 Following the habitat assessment, targeted reptile surveys were undertaken in accordance with best practice guidelines contained within the Herpetofauna workers' manual (Ref 6-20). This involved the use of artificial refugia, such as corrugated metal and roofing felt sheets. A total of 62 refugia were deployed in potentially suitable habitat initially, increasing to 77 refugia for the second visit onwards. Twenty survey visits were carried out between July and October 2010 over a period of 13 days. Refugia were also deployed within the Exemplar site and checked on 10 occasions during the period May to September 2010.

4.9.1.4 The population estimate was based on general population assessment criteria provided by Froglife (Ref 6-21) which is based on the number of adults seen by observation or under refugia by one person in one day, and assumes a density of up to 10 refugia per hectare.

## 4.10 Breeding bird survey

4.10.1.1 A breeding bird survey was carried out by an experienced surveyor, who undertook three survey visits between 25th May and 29th July 2010. This survey period allowed for the detection of summer migrant arrivals as well as those species present year-round.

4.10.1.2 All survey work was carried out in suitable conditions (avoiding heavy rain, fog or strong wind) and at the optimal time for recording activity (between 4 hours after sunrise and 4 hours before sunset). The survey methodology broadly followed standard survey guidance described in the Common Bird Census Instructions (Ref 6-22). During each survey visit, the surveyor systematically walked the field boundaries and habitat features within the Masterplan site (excluding the area where access was not available). A pair of 10x42 binoculars was used to observe signs of breeding activity. The identity and location of all birds seen or heard were recorded onto large scale maps using standard British Trust for Ornithology (BTO) species codes.

4.10.1.3 The following signs of bird breeding activity were also recorded:

4.10.1.4 Possible Breeding

- Observed in suitable nesting habitat;
- Singing male.

4.10.1.5 Probable Breeding

- Pair in suitable nesting habitat;
- Courtship and display;
- Visiting a probable nest site;
- Agitated behaviour;
- Confirmed Breeding;
- Used nest or eggshells;
- Recently fledged young;
- Adults entering or leaving an occupied nest;
- Adults carrying faecal sac of food for young;
- Nest containing eggs;
- Nest with young.

4.10.1.6 Access was not available to a parcel of land associated with Himley Farm during 2010. As such, Hyder undertook breeding bird surveys of this area on three occasions during 2011 (12th April, 6th May and 24th June) in accordance with the survey methodology described with one modification regarding the timing. The surveys commenced just after dawn until 9am under optimal weather conditions

4.10.1.7 On each of the surveys, an experienced ornithologist walked a transect route across the site, identifying any birds present by sight or song. The behaviour of each bird identified was recorded in order to indicate whether the individual was likely to be breeding on site (as described above). Particular attention was paid to species of ‘conservation concern’ or those receiving special protection, that is those that receive protection under Schedule 1 of the Wildlife and Countryside Act (WCA) 1981 (as amended), Section 41 (NERC Act) species and those that are of high conservation concern in the UK (red or amber listed in the 2009 Birds of Conservation Concern (BoCC) (Ref 6-23).

## 4.11 Wintering bird survey

4.11.1.1 Wintering bird surveys were carried out by Hyder on three occasions from early morning to late afternoon between January and March 2011. On each occasion, approximately three days were required to survey the site (12th – 14th January, 1st – 4th February and 7th – 9th March 2011). The site was walked systematically by an experienced surveyor. Binoculars were used to observe birds, and the identity and locations of all birds seen or heard were recorded onto large scale maps using standard BTO species and activity recording codes as presented in Appendix 1 of *Bird Monitoring Methods* (Ref 6-24)). In addition, the site was visited at dawn and dusk each month to ascertain whether barn owls foraged within the Masterplan site.

## 4.12 Bat roost surveys

4.12.1.1 The field survey comprised an initial scoping site visit, followed by emergence/re-entry surveys and activity surveys. The scoping survey identified features with the potential to support roosting bats and those features likely to be of value to commuting and foraging bats for subsequent transect surveys. Potential roost sites were identified following standard survey guidance, such as that provided by the Bat Workers Manual (Ref 6-25) and the Bat Survey – Good Practice Guidelines that were current at that time (Ref 6-26).

4.12.1.2 Each potential roost site identified was subject to three independent surveys, two at dusk and one at dawn. Where possible, these surveys were spread across a number of weeks or months, such that seasonal changes in bat activity could be taken into account. In addition, remote surveys using Anabat detectors installed overnight were also undertaken. Where Anabats were used, some sites were surveyed twice because of the considerable volume of data collected using this equipment. In addition, dusk and dawn surveys were carried out by bat surveyors using hand-held heterodyne and time expansion detectors. The dusk surveys were timed to occur between 30 minutes prior to sunset until 90 minutes after sunset. The dawn surveys were undertaken between 120 minutes prior to sunrise until sunrise. All surveys were carried out in suitable weather conditions. Where recorded, data was analysed using computer programmes to confirm the bat species. Observations such as bat characteristics, species, numbers, flight directions, height and other behaviours, such as feeding buzzes, were noted during the surveys. These surveys were undertaken in the period 17th May to 23rd September 2010.

4.12.1.3 Access to the parcel of land associated with Himley Farm was granted in July 2010. At that time the owner of Himley Farm confirmed that the barn supported a brown long-eared bat (*Plecotus auritus*) roost. Precise details of the roost were not available but it was understood that small numbers of bats used the roost (possibly only two bats). Several of the other farm buildings also had the potential to support roosting bats.

4.12.1.4 Two dusk emergence surveys (27th July and 14th September) and one dawn re-entry survey (28th July) were undertaken of the buildings associated with Himley Farm. Each surveyor carried a Pettersson D240 time-expansion bat detector, with the frequency set to 45kHz. The detector was connected to a digital recorder and any bat calls heard were recorded using time-expansion. A voice recording was made to accompany each bat recording, describing the time, location and, if seen, behaviour of the bat. The bat calls recorded were analysed using the 'Batsound' computer programme to identify the species.

## 4.13 Bat activity surveys

4.13.1.1 For the purposes of the Arup survey, the Masterplan site was walked using four transects (north, central-west, central-east and south). Each transect route was walked on two separate occasions following a roost emergence survey, thus they were surveyed from 90 minutes after

dark, for a further 90 minutes. The surveys were carried out in suitable weather conditions and the various observations listed above were noted. These surveys were undertaken between 18th May and 6th July.

4.13.1.2 As described previously, access was not available to a parcel of land associated with Himley Farm during 2010. The hedgerow network in this area was considered to provide suitable foraging and commuting routes for bats roosting nearby. Following the emergence surveys on the 27th and 28th of July and on 14th September 2011, activity surveys were carried out which involved walking a pre-determined transect focusing on features of potential value to foraging and commuting bats, namely the hedgerows. The survey methodology employed followed the guidelines that were in use at that time (Ref 6-26). For the purposes of this survey, three transects were walked within the survey area. Each surveyor carried a Pettersson D240 time-expansion bat detector, with the frequency set to 45kHz. The surveyors walked at a slow pace and stopped, for three minutes at a time, at evenly spaced 'listening points' along the way. At each listening point, the surveyor pressed the time expansion button on the detector repeatedly in order to improve the chances of hearing bat species calling at lower or higher frequencies than 45kHz. All bat calls heard whilst walking or whilst at the listening points were recorded and analysed using the 'Batsound' computer programme to identify the species

## 4.14 Dormouse survey

4.14.1.1 The field survey followed the methodology outlined in the Dormouse Conservation Handbook (Ref 6-27). This involved installing dormouse nest tubes within suitable habitat at a density of one per 20m of hedgerow and woodland edge habitat. The tubes were deployed in various locations these included:

- the hedgerows associated with the consented Eco development (the Exemplar site);
- the woodland west of Home Farm;
- the vegetation alongside the River Bure within the Exemplar site;
- two hedgerows north of Hawkwell Farm;
- the vegetation alongside the tributary of the River Bure to the east of Hawkwell Farm; and
- the edge of the plantation west of Himley Farm.

4.14.1.2 The tubes were checked for signs of dormouse activity on a monthly basis between early May and October inclusive. In addition, a search for characteristically chewed Hazel (*Corylus avellana*) nuts was undertaken in late October.

## 4.15 Water vole survey

4.15.1.1 A field survey for water voles was undertaken on the 7th and 16th June and 28th August 2010. This involved undertaking a habitat suitability assessment to determine the likely locations of water voles; flow conditions, food availability and cover; water quality and signs of mink (*Neovison vison*) were recorded. Following this, a more detailed survey for water voles was undertaken in the most suitable areas. This followed standard survey methodology as described in the Water Vole Conservation Handbook (Ref 6-28) and involved recording the following field signs:

- Faeces/latrines

- Feeding stations
- Burrows
- Nests
- Footprints.

## 4.16 Otter survey

4.16.1.1 A field survey for otters was undertaken on the 7th and 16th June and 28th August 2010. This involved surveying suitable habitat for signs of use by otter including:

- Spraints;
- Footprints;
- Feeding remains;
- Otter paths;
- Otter holts and couches.

## 4.17

4.17.1.1 [redacted]

4.17.1.2

4.17.1.3

## 4.18 Other mammals of conservation concern

4.18.1.1 Incidental observations of other species of conservation concern such as brown hare were made during the surveys described above.

## 4.19 Ground-truthing survey

4.19.1.1 The Masterplan site was resurveyed in March 2011 and October 2013 to confirm that the site remained as previously recorded and confirm that no new constraints have appeared since the 2010 surveys.

# 5 Limitations and assumptions

### Limitations to survey

5.1.1.1 A full survey season was available for the surveys and therefore they were all undertaken at the appropriate time of year and under appropriate weather conditions. Weather conditions did affect the aquatic invertebrate surveys to the extent that it was not possible to sample for aquatic invertebrates within the watercourses during the summer months due to the lack of water in these features. However, it appears that these watercourses regularly experience such events and that the aquatic fauna present are adapted to such conditions. It is considered that data collected in 2010 is representative of conditions on site; this is further validated by the results of the aquatic invertebrate samples that were taken in 2012. Although Anabats were placed outside potential tree roosts on three occasions, the equipment failed to work on the second and third occasions when placed outside three of the potential tree roosts. Whilst it is possible, therefore, that these three trees may contain tree roosts that were not detected it was not considered necessary to survey these features further because the trees are located within hedgerows and these hedgerows, together with an appropriate buffer zone, would be retained within the Masterplan layout.

### Extent of data

5.1.1.2 The Masterplan site has been surveyed comprehensively, and the survey area extended where appropriate in order that potential impacts of the Bicester Eco development can be assessed. A large pond located within the grounds of Caversfield House approximately 140m north-west of the Masterplan site boundary and a pond located approximately 350m to the east of the site were identified from Ordnance Survey maps but due to access restrictions could not be comprehensively surveyed for great crested newts. However, the large pond in Caversfield House is understood to support fish and therefore considered unsuitable for use by great crested newts. Given the distance between the site and the pond to the east, and its separation from the site by two busy roads, it was considered unlikely that great crested newts (should they be present), would regularly forage within the Masterplan site. Therefore, the lack of survey data from these two ponds will not prevent an assessment of the impacts of the development on great crested newts to be made, and is not considered to constitute a significant gap in the data.

### Life span

5.1.1.3 There is no guidance as to how long ecological survey results remain valid (although Natural England usually request that data relating to European protected species should be less than three years old. Provided that the existing management of the land continues, the survey information collated should be sufficient to inform the impact assessment. This approach has been further validated by the October 2013 walkover survey that revealed that the conditions on the site had not altered. Given the phased nature of the development and the length of the ‘build-out’ time, pre-construction surveys will need to be undertaken prior to any development

taking place for each Phase of the development to ensure legal compliance. The results of these surveys would inform the detail of the Construction Environmental Management Plan and any bespoke ecological methods statements that might be required.

### Changes to best practice guidelines

5.1.1.4 Since the surveys were undertaken in 2010 and 2011 the best practice bat survey guidelines have been updated (Ref 6-30). In order to comply with these revised guidelines, the bat activity surveys undertaken by Arup would need to be supplemented by autumn surveys. However, Hyder carried out a bat activity survey in autumn, and although it only covered part of the Masterplan site, the survey results (species and numbers of bats) were similar to those revealed during the Arup surveys. It is therefore not considered necessary to undertake further surveys to inform the impact assessment.

# 6 Results

## 6.1 Designated sites

### Sites of International Importance

6.1.1.1 There are no statutory designated sites of International or European importance to nature conservation within 10km of the Masterplan site. The closest is a collection of meadows called Oxford Meadows Special Area of Conservation (SAC), which are located 14 km from the southern boundary of the Masterplan site and separated from the site by major roads and the M40 motorway. These meadows are of value for the lowland hay meadow plant communities that they support that include uncommon and rare plant species. These hay meadows are not hydrologically linked to the Masterplan site and the Masterplan site does not support the plant communities that this site has been designated for.

### Sites of National Importance

6.1.1.2 There are no statutory designated sites of National importance to nature conservation within the Masterplan site (known as Sites of Special Scientific Interest or SSSI). There are five SSSIs within 5 km of the Masterplan site, as listed in Table 6-1 below. Of these, Ardley Cutting & Quarry, Weston Fen, and Wendlebury Meads & Mansmoor Closes have been designated (at least in part) for their biological interest and therefore, are considered to be of National importance to nature conservation. Stratton Audley Quarries, Ardley Trackways and Ardley Cutting & Quarry are geological SSSIs.

6.1.1.3 Ardley Cutting & Quarry is partially located on the mainline railway line that bisects the Masterplan site. This site is therefore linked to the Masterplan site via the railway. However, the railway is not accessible to the public and there are no public rights of way within the SSSI. In addition, the railway embankment within the Masterplan site is scrub and tree covered embankment. There are small open areas that are likely to support the calcareous grassland species for which the SSSI is designated; but it's unlikely that the embankment supports the rare invertebrates associated with the SSSI. This SSSI supports great crested newts, which were also recorded within the Masterplan site. However, the ponds within the Masterplan site boundary that were found to support great crested newts were almost 3 km from the quarry pools. Furthermore, the absence of great crested newts was confirmed from the ponds that are between the quarry pools and the ponds on the Masterplan site that support great crested newts. Consequently, it is not considered that the great crested newt meta-population within the Masterplan site have close links to the SSSI newt population.

6.1.1.4 There are a further nine SSSIs within 10 km of the Masterplan site; two of these, Kirtlington Quarry and Shipton-on-Cherwell and Whitehill Farm Quarries, are geological SSSIs with the

remaining eight sites being designated for their biological interest, and therefore, are considered to be of National importance to nature conservation. These SSSIs are listed, together with the reasons for designation and their location with respect to the Masterplan site, in Table 6-2 below.

6.1.1.5 It should be noted that the Masterplan site was not found to contain the habitats that the biological SSSIs have been designated for. Although a number of these SSSI are located alongside watercourses or associated with water features only Otmoor has hydrological links to the River Bure (the river that passes through the Masterplan site). The town of Bicester and a number of water treatment works are located between the Masterplan site and Otmoor.

Table 6-1: Statutory designated sites (SSSI) within 5 km

| Site Name | Reason for designation | Location |
|---|---|---|
| Ardley Cutting & Quarry | A railway cutting and quarry of geological and biological importance. It is one of the largest limestone grasslands in the Oxfordshire Cotswold. It supports a valuable calcareous grassland flora, a valuable woodland flora and the seasonally wet pool in the quarry base is contiguous with wetland vegetation. The site as a whole is of value to invertebrates and supports a large population of great crested newts. | A linear site that at its closest point is 315m north-west of the Masterplan site. The M40 motorway and a number of minor roads cross this SSSI. |
| Ardley Trackways | A series of working quarries that form a geological site of value for its strata and fossil record. | 1.3km east of the Masterplan site. Separated from the Masterplan site by the M40 motorway. |
| Stratton Audley Quarries | A geological site of value for its strata and fossil record. | 1.9 km east of the Masterplan site. Separated from the Masterplan site by built development and the main 'A' road the A4421. The A4421 is one of the major routes into Bicester. |
| Weston Fen | A calcareous fen that supports valuable habitats including reed bed, marshy grassland, carr woodland, calcareous grassland, stream and semi-natural broad-leaved woodland. These habitats support rare beetles, a rare marsh snail and breeding read warblers. | 4.6 km south-west of the Masterplan site. Separated from the Masterplan site by the M40 motorway. |
| Wendlebury Meads & Mansmoor Closes | Unimproved neutral meadows that support a diverse and valuable flora, of value to birds and butterflies. (The closes are also of landscape and archaeological importance.) | 4.7 km south of the Masterplan site separated from it by the main road linking Bicester to Oxford (the A41) and the M40 motorway. |

Table 6-2: Statutory designated sites (SSSI) between 5km and 10km of the Masterplan site

| Site Name | Reason for designation | Location |
|---|---|---|
| Arncott Bridge Meadows | Hay meadows in the River Ray floodplain comprising unimproved neutral grassland that support a diverse and valuable flora that includes rare and uncommon plant species. | 6.5 km south-east of the Masterplan site separated from it by the main road linking Bicester to Oxford (the A41). |
| Kirtlington Quarry | A geological site of value for its fossil record. | 6.8 km south-west of the Masterplan site separated from the site by the M40 motorway and the town of Kidlington. |
| Otmoor | Herb-rich damp grassland on the floodplain of the River Ray, with woodland pools and ditches. Of importance to invertebrates. Also of importance to breeding and overwintering wildfowl and waders. Also of value to raptors and passerines. | 8 km south of the Masterplan site separated from it by the main road linking Bicester to Oxford (the A41) and the M40 motorway. |
| Bestmoor | Semi-improved floodplain meadow that supports rear and uncommon plants. Of value to wintering wildfowl, hoverflies and damselflies. | 8.3 km north-west of the Masterplan site, separated from it by the M40 motorway and the Oxford Canal. |
| Whitecross Green & Oriel Woods | Ancient woodland that supports a diverse and valuable flora also of value to invertebrates and rare butterflies in particular. | 8.6 km south of the Masterplan site separated from it by the main road linking Bicester to Oxford (the A41) and the M40 motorway. |
| Long Herdon Meadow | Flood meadow that supports a diverse and valuable grassland flora. Winter flooding of value to wading birds, of potential value to breeding snipe (*Gallinago gallinago*) and curlew (*Numenius arquata*). Rare damselflies also recorded. | 8.7km east of the Masterplan site. Separated from the Masterplan site by Bicester. |
| Murcott Meadows | These meadows support unimproved grassland of value to flora and fauna, a small block of woodland of value to a rare species of butterfly and a pond of value to invertebrates. | 9 km south of the Masterplan site |

| Site Name | Reason for designation | Location |
|---|---|---|
| Shipton-on-Cherwell and Whitehill Farm Quarries | A geological site of value for its fossil record. | 9.5 km to the south-west |
| Tingewick Meadows | These meadows support a diverse range of habitat including calcareous and neutral grassland, fen vegetation and ditches rich in bryophytes. Also of value to invertebrates. | 9.5 km north-east of the Masterplan site, separated from the site by the main road the A4421. |

## Sites of County Importance

6.1.1.6 There are no non-statutory designated sites of County Importance to nature conservation within the Masterplan site. In Oxfordshire, these sites are known a Local Wildlife Sites (LWS). There are eighteen LWSs within 5km of the Masterplan site (two of which include proposed extensions), and a further five proposed LWSs. Such sites have been assessed as being of County importance by an expert panel in accordance with their guidelines.

6.1.1.7 In addition, Bure Park Local Nature Reserve (a statutory designated site) is situated 20m east of the Masterplan site separated from it by Howes Lane (the main ring road around Bicester the A4095). This site supports a mosaic of habitats (grassland, watercourse, ponds, scrub and woodland) with records of water voles and great crested newt.

6.1.1.8 Table 6-3 below provides further details regarding LWS and their location relative to the Masterplan site.

Table 6-3: Non-statutory designated sites (LWS)

| Site Name | Reason for designation | Location |
|---|---|---|
| Bicester Airfield (and proposed extension) | Areas of species-rich grassland and rough grassland. | 1km to the east of the site. Linked to the Masterplan via A4095 and minor roads. |
| Twelve Acre Copse | Ancient semi-natural woodland. | 1.2km north-west of the Masterplan site, linked to the Masterplan site by the minor road the B4100. |
| Trow Pool | Fishing lake, signs of otter activity recorded. | 1.2km west of the Masterplan site, separated from the Masterplan site by the M40 motorway. Linked to the Masterplan site by public footpaths and minor roads. |
| Stratton Audley Quarries | Wetland and limestone grassland, also a SSSI see above. | 1.7km from Masterplan site. |
| Ardley Fields Quarry | Proposed LWS | 1.8km to the north-east of the Masterplan site. |
| Stoke Little Wood | Ancient semi-natural and ancient replanted woodland. | 2km north-west of the Masterplan site, linked to the Masterplan site by the minor road the B4100. |

| Site Name | Reason for designation | Location |
|---|---|---|
| Jarvis Lane | Proposed Local Wildlife Site | 2.2km east of the Masterplan site, linked to the Masterplan by the A4421 and minor roads and tracks. |
| Bicester Wetland Reserve | Wetland and grazing marsh of value to wildfowl and waders. | 2.2km south-east of the Masterplan site. Separated from the Masterplan site by the A41 main road, site not readily accessible by foot with no public rights of way, access also restricted to members of the ornithological society. |
| Stoke Wood | Ancient semi-natural and ancient replanted woodland. Woodland Trust reserve. | 2.5km north-west of the Masterplan site, linked to the Masterplan site by the minor road the B4100 and public footpaths. |
| Skimmingdish Lane Fields | Proposed Local Wildlife Site | 2.5km south-east of the Masterplan site, linked to the Masterplan site by a series of minor roads and the A4095. |
| Gavray Drive Meadows | Lowland meadows of value to hairstreak butterflies. | 2.6km south-east of the Masterplan site, separated from the Masterplan site by Bicester. Linked to the Masterplan site by the mainline railway. Linked to the Masterplan site via minor roads and paths. |
| Graven Hill | Ancient semi-natural woodland. | 3.2km south-east of the Masterplan site. Separated from the Masterplan site by the A41 main road. No public rights of way across this former Ministry of Defence Site. |
| Upper Heyford Airfield (and proposed extension) | Calcareous grassland. | 3.4km north-west of the Masterplan site, separated from the Masterplan site by the M40 motorway, with no public footpath leading to or across the airfield. |
| Stoke Bushes | Ancient semi-natural and ancient replanted woodland. | 3.5km north of the Masterplan site, linked to the Masterplan site via minor roads and the local footpath network. |
| Meadows NW of Blackthorn Hill | A group of ridge and furrow meadows enclosed by hedgerows. | 4.5km to the south-east of the Masterplan site, linked to the Masterplan site via A4095 and minor roads. |
| Kirklington Park | Proposed Local Wildlife Site | 4.6km south west of Masterplan site, linked to the Masterplan site by the A4095. |
| Warmough Copse | A small fragment of ancient coppice woodland. | 4.6km south of the Masterplan site. Is close to the A41. |
| Cutter's Brook Meadows | Two hay meadows on the floodplain of the River Ray | 4.6km to the south-east of the Masterplan site, linked to the Masterplan site via A4095 and minor roads. |
| Hopyard Spinney | Ancient semi-natural woodland and wetland habitat. | 4.9km north-east of Masterplan site, linked to the Masterplan site by the A4095 and the A4421. |

| Site Name | Reason for designation | Location |
|---|---|---|
| Meadow east of Fringford | Wet meadow that has been planted with poplars. | 4.9km north east of Masterplan site, linked to the Masterplan site by the A4095 and A4421. |
| Kirklington Park Lake (North) | A small lake supporting a rich variety of aquatic plants. | 4.9km south west of Masterplan site, linked to the Masterplan site by the A4095. |
| Field by Beacon Hill Ditch | Proposed Local Wildlife Site | 4.9km south-west of the site. |
| Pool Spinney | An area of wet woodland. | 5km north-east of the Masterplan site, linked to the Masterplan site by the A4095 and the A4421. |

# 6.2 Plants and habitats

## Notable plant species

6.2.1.1 TVERC provided records for a number of notable plant species within the 5km area of search. None of these records relate to the Masterplan site itself, but there is the potential that two of these species: Meadow Clary (*Salvia pratensis*) and Bluebell (*Hyacinthoides non-scripta*) could be present within suitable habitats on the Masterplan site. The former may be present on the railway embankment, although most of the grassland was covered by scrub and thus unsuitable for this species. Bluebell could be present within the hedgerows, but Bluebells were not recorded on site during the botanical surveys of the hedgerows or the woodlands on the Masterplan site. It would appear that the hedgerows and woodlands are unlikely to support a natural population of native Bluebells, which are generally found in habitats of long standing.

## General site description

6.2.1.2 The surveys revealed that the site comprised predominantly arable fields cropped with cereals, legumes and Oil-seed Rape (*Brassica napus*). These fields had narrow or absent field margins of limited intrinsic nature conservation value. The most commonly recorded species in the field margins were species associated with unmanaged and/or nutrient-rich soils and common arable weeds. These included False Oat-grass (*Arrhenatherum elatius*), Common Couch (*Elytrigia reptans*), Common Nettle (*Urtica dioica*), Pineappleweed (*Matricaria discoidea*), Scented Mayweed (*Tripleurospermum odoratum*) and Scarlet Pimpernel (*Anagalis arvensis*). The fields that surrounded Himley Farm were less intensively managed and supported more ruderal weed species and common arable weeds, these included Creeping Thistle (*Cirsium arvense*), Smooth Sow-thistle (*Sonchus oleraceus*), Scarlet Pimpernel (*Anagalis arvensis*), Common Poppy (*Papaver rhoeas*), Round-leaved Fluellen (*Kickxia spuria*) and Sharp-leaved Fluellen (*Kickxia elatine*). Some of the arable fields had a sown grass margin that was less diverse.

6.2.1.3 The Masterplan site is bisected by the mainline railway that links Bicester to Banbury. At the point that the railway crosses the Masterplan site, the railway is on an embankment covered by trees and scrub. Most of the farmsteads were occupied with gardens that contained regularly mown (amenity) grassland. However, the buildings and land adjacent to Gowell Farm in the southern half of the Masterplan site were derelict and unmanaged.

6.2.1.4 A number of semi-natural habitats were identified within the Masterplan site, these comprised:

- semi-natural and plantation broadleaved woodland;
- species-rich hedgerows supporting five or more woody species;

- running water;
- standing water;
- ponds; and
- improved grassland.

## Woodland

6.2.1.5 Within the Masterplan site, there were two blocks of semi-natural broad-leaved woodland (both west of Home Farm), one block of semi-mature broad-leaved plantation (close to Hawkwell Farm) and several belts of broad-leaved plantation woodland (close to Himley Farm, Aldershot Farm and Home Farm). Woodlands and farm locations are shown on Drawings 6-1.

6.2.1.6 Most of the canopy trees in the two blocks of woodland to the west of Home Farm had been felled. The Ash (*Fraxinus excelsior*) trees had been replaced by recently planted Scots Pine (*Pinus sylvestris*) and Norway Maple (*Acer platanoides*). The canopy comprised a small number of retained Ash trees, but the shrub layer of Hawthorn (*Crataegus monogyna*), elm (*Ulmus* sp.) and Elder (*Sambucus nigra*) formed the main canopy of these woodlands. The ground flora largely comprised Dog's Mercury (*Mercurialis perennis*) and Common Nettle (*Urtica dioica*) (for further details of other common plant species recorded in these woodlands see the quadrat data presented in Appendix 6B). Analysis of the detailed botanical survey results revealed that these woodlands most closely resembled the NVC woodland plant community W8d Ash-Field Maple (*Acer campestre*) – Dog's Mercury woodland Ivy (*Hedera helix*) sub-community. However, the ground flora had been adversely affected by ground disturbance associated with tree felling, replanting and historical use as a site in which to rear game birds.

6.2.1.7 It would appear that the woodland close to Hawkwell Farm would have had a canopy of Ash trees. Once again these trees had been felled, but this time they had been replaced with Grey Poplar (*Populus* x *canescens*) trees. The understorey was Hawthorn-dominated, with Wild Privet (*Ligustrum vulgare*), Ash and Field Maple also recorded. The dominant ground flora species were Ivy and Dog's Mercury (see Appendix 6B for more details). This woodland is considered to most closely resemble W8e Ash-Field Maple-Dog's Mercury woodland Herb-Robert (*Geranium robertianum*) sub-community. These woodlands did not support particularly diverse or valuable ground floras. They did not support the diversity of plant species associated with ancient woodlands. It would appear that these woodlands are not ancient in origin, and this was confirmed by the mapping available of the MAGIC website (Ref 6-2).

6.2.1.8 The belts of broad-leaved plantation woodland appeared to be approximately 20 years old, and supported a diverse mix of native broad-leaved trees and shrubs, including Ash, Pedunculate Oak (*Quercus robur*), Hazel, Field Maple (*Acer campestre*) and Cherry (*Prunus* sp.). Ground flora where the trees and shrubs were less dense was dominated by common grasses and ruderal herbs associated with unmanaged grasslands on nutrient-rich soils. These included False Oat-grass with Cock's-foot (*Dactylis glomerata*), Common Nettle and Cleavers (*Galium aparine*). Again the woodland did not support a diverse or valuable ground flora.

6.2.1.9 None of the woodlands within the Masterplan site would be classified as Section 41 (NERC Act) habitats. However, the LBAP does recognise that woodlands are a scarce resource in this part of the Cherwell District.

## Grasslands

6.2.1.10 Most of the grasslands within the site were found to support improved grassland. These grasslands support a limited diversity of common grass species of limited nature conservation value, with very few forbs (non-grass species). The quadrat data collected from the improved

grassland fields associated with Home Farm and Hawkwell Farm is presented in Appendix 6C, Drawing 6-2 shows the location of these fields.

6.2.1.11 None of the grasslands within the Masterplan site would be classified as Section 41 (NERC Act) habitats.

## Hedgerows

6.2.1.12 A total of 83 hedgerows were targeted for detailed survey by Arup in 2010. The majority of these were of high or very high ecological value under the HEGS assessment and considered to be 'important' under the Wildlife and Landscape Criteria of the Hedgerows Regulations (1997). A further 26 hedgerows were assessed by Hyder using the Hedgerows Regulations and once again, the majority were considered to be 'important' under these regulations.

6.2.1.13 The majority of the hedgerows within the Masterplan site were species-rich supporting five or more woody species. The hedgerows largely comprised Hawthorn, Blackthorn and Elm with additional species including Elder (*Sambucus nigra*), Buckthorn (*Rhamnus cathartica*) Crab-apple (*Malus sylvestris sens. lat*.), Dogwood (*Cornus sanguinea*), Field-rose (*Rosa arvensis*) and Wayfaring-tree (*Viburnum lantana*). Many of the hedgerows were associated with dry ditches that were shaded by the hedgerow shrubs. The hedgerow ground floras were species-poor, and largely comprised False Oat-grass and Common Nettle. Common hedgerow ground flora species and climbing plants were recorded in some of the hedgerows, including Lord's and Ladies (*Arum maculatum*), Dog's Mercury, Hedge Woundwort (*Stachys sylvestris*), Garlic Mustard (*Alliaria petiolata*), Honeysuckle (*Lonicera periclymenum*), Black Bryony (*Tamus communis*), White Bryony (*Bryonia dioica*) and Ivy.

6.2.1.14 Several of the hedgerows supported mature and semi-mature trees. The most commonly recorded tree species were Ash, Pedunculate Oak, Horse-chestnut (*Aesculus hippocastanum*) and willow (*Salix* sp.). More detail regarding the composition of the hedgerows that were subject to survey is presented in Appendix 6D; Drawing 6-2 shows the locations of the hedgerows that were surveyed.

6.2.1.15 Barberry (*Berberis vulgaris*) was recorded in six locations in five hedgerows within the Masterplan site (five hedgerows were in the northern half of the site one in the southern half). Although this plant is not rare or uncommon it is noteworthy since it is the food plant of a protected moth (the barberry carpet) see Terrestrial Invertebrates (below).

6.2.1.16 Hedgerows are a Section 41 (NERC Act) habitat.

## Ponds

6.2.1.17 There were four ponds within the Masterplan site: the largest was Crowmarsh pond (Pond 6), with two small ponds associated with Himley Farm (P14 and P15), and one recorded to the north-west of Hawkwell Farm (P10). Pond locations shown on Drawing 6-2.

6.2.1.18 Crowmarsh pond had a deep layer of silt at the bottom. It supported a diverse wetland flora that included Fennel-leaved Pondweed (*Potamogeton pectinatus*), Opposite-leaved Pondweed (*Groenlandia densa*), Horned Pondweed (*Zannichellia palustris*), Water Mint (*Mentha aquatica*), False Fox-sedge (*Carex otruabae*), Common Spike-rush (*Eleocharis palustris*) and Brooklime (*Veronica beccabunga*). The small pond to the north-west of Hawkwell Farm (pond 10 on Drawing 6-2) supported Common Water-starwort (*Callitriche stagnalis*) and Pond Water-crowfoot (*Ranunculus peltatus*).

6.2.1.19 The northern pond at Himley Farm was a small pond approximately 10m by 5m in area within an arable field (P14 on Drawing 6-2). In September 2011, the bottom of the pond was damp but held no water; the damp mud was covered with Water-crowfoot (*Ranunculus sp.)*. Emergent

and marginal vegetation included Branched Bur-reed (*Sparganium erectum*) and Water Mint (*Mentha aquatic*a). The banks of the pond were covered with Great Willowherb (*Epilobium hirsutum*) and False Oat-grass. This pond held water in spring 2011 and in October 2013.

6.2.1.20 The southern pond at Himley Farm was a small pond approximately 20m by 4m in area, with island in the middle and surrounded by heaps of spoil (P15 on Drawing 6-2). This pond was surrounded by an earth bank which was almost vertical along the southern edge. Emergent vegetation included Hard Rush (*Juncus inflexus*), Soft-rush (*Juncus effusus*), Water Mint, Common Club-rush (*Schoenoplectus lacustris*). Scrub comprising Goat Willow (*Salix caprea*), Crack-willow (*Salix fragilis*) and Bramble was present around the pond, with mature Crack-willow trees present around the western edge of the pond. Tall ruderal species including Great Willowherb and Common Nettle were also present.

6.2.1.21 Ponds are a Section 41 (NERC Act) habitat.

### Watercourses

6.2.1.22 The River Bure and two tributaries of this watercourse cross the Masterplan site. The upper reaches of the tributaries are winterbournes and were dry for large parts of the year. Where water is present, common wetland plants have been recorded, including Lesser Water-parsnip (*Berula erecta*), Fool's Watercress (*Apium nodiflorum*), Reed Sweet-grass (*Glyceria maxima*), Common Reed (*Phragmites australis*), Bittersweet (*Solanum dulcamara*), Meadowsweet (*Filipendula ulmaria*) and Marsh Marigold (*Caltha palustris*).

6.2.1.23 Rivers are a Section 41 (NERC Act) habitat.

## 6.3 Aquatic invertebrates

6.3.1.1 The desk study revealed that North-American signal crayfish (*Pacifastacus leniusculus*) were present in the catchment of the River Bure. A dead signal crayfish was recorded close to Crowmarsh pond and the targeted surveys did not reveal the presence of white-clawed crayfish in the Masterplan site or the wider survey area. Given the negative survey result, and the fact that signal crayfish and native crayfish rarely co-exist, it is considered extremely unlikely that white-clawed crayfish are present within the Masterplan site.

6.3.1.2 Historical records were provided of four species classified as Nationally Scarce (Notable) Nb and three species listed by TVERC as being on the pre-1994 IUCN Red List species. Of the three on the pre-1994 IUCN Red List, one is now classified as Regionally Extinct: a whirligig (*Gyrinus natator*); one is listed as Critically Endangered on the current UK Red List: a crawling water beetle (*Haliplus furcatus*); and one is now considered to be Nationally Scarce: a long-toed water beetle (*Dryops similaris*). The records of the latter two species were located over 4km from the Masterplan site and it is considered unlikely that they would be present within it as they require fen vegetation that is not found within the Masterplan site.

6.3.1.3 The majority of other records provided related to aquatic invertebrates within the SSSIs that were closest to the Masterplan Site, including Ardley Cutting and Quarry SSSI and Stratton Audley Quarry SSSI, and all records (with the exception of one water beetle) were located within waterbodies that are at least 2km from the Masterplan site or located beyond a barrier to movement, such as the M40 or the urban conurbation of Bicester. The only record within close proximity was a Nationally Scarce (Notable) Nb scavenger water beetle (*Hydrochus angustatus*). This species was recorded within a pond in Bucknell, approximately 480m from the Masterplan site; this was a single historical record dated from 1988, and if present on the Masterplan site it would be associated with the ponds.

6.3.1.4 The 2010 aquatic invertebrate surveys revealed that the tributary of the River Bure supported a small number of common and widespread species. Twenty two aquatic invertebrate species were recorded within Crowmarsh pond, 10 species were recorded in the tributary of the River Bure with the sample taken from closest to the confluence with the Bure supporting nine of these species. The spring/ stream that fed Crowmarsh pond supported the fewest species, only two.

6.3.1.5 The aquatic invertebrate samples that were taken to provide a baseline for the consented Eco development on the Exemplar site revealed that water quality within the River Bure was reasonable in all three sections of the river. The water was relatively clean and clear, although there were some signs of localised enrichment associated with cattle crossing the river upstream of the sampling sites. Limited aquatic plants were recorded within the channel and small amounts of filamentous algae were recorded in places.

6.3.1.6 All of the aquatic invertebrates that were recorded within the River Bure were relatively common species and no species of conservation concern were recorded. Species that are sensitive to water pollution were recorded in the samples indicating that the water was of 'moderate' quality. The samples of the Bure that were taken revealed that it supported between 19 and 21 species. In contrast to the tributary of the Bure the most diverse sample was the upstream sample (Sample location 1 on Drawing 6-2).

6.3.1.7 The data collected during the 2011 surveys is presented in full in Appendix 6E, with the data collected in 2010 presented in the report presented in Appendix 6F. The watercourses were not found to support a valuable aquatic invertebrate fauna.

## 6.4 Terrestrial invertebrates

6.4.1.1 Records of 15 butterfly species and 26 moth species were recorded within 5km of the Masterplan site were provided by TVERC. The majority of these species (24) are listed on Section 41 of the NERC Act.

6.4.1.2 TVERC provided records of the following species of conservation concern (species of Principal Importance on Section 41 NERC Act species) within 5km of the proposed scheme: dingy skipper (*Erynnis tages*); grizzled skipper (*Pyrgus malvae*); brown hairstreak; white-letter hairstreak (*Satyrium w-album*); wall (*Lasiommata megera*); small blue (*Cupido minimus*); small heath (*Coenonympha pamphilus*); grayling (*Hipparcia semele*); wood white (*Leptidea sinapis*); white admiral (*Limenitis camilla*); marsh fritillary (*Euphydryas aurinia*) and pearl-bordered fritillary (*Boloria euphrosyne*). Only one historical record of each of the latter two species was provided. Another species of conservation concern (as defined by Butterfly Conservation) that was identified within the search area was adonis blue (*Polyommatus bellargus*), this species is not listed on the NERC Act. In addition, a single record dating from 2000 was provided of the Scarce four-dot pin-palp (*Bembidion quadripustalatum*), recorded from Bicester Wetland Reserve. This ground beetle is listed on Section 41 of the NERC Act; however, it is considered unlikely to occur on the Masterplan site as its preferred habitat is wet mud margins in a wetland mosaic habitat.

6.4.1.3 The Upper Thames Branch of Butterfly Conservation also provided butterfly records from the 12 1km squares overlapping the Masterplan site boundary, dating from 1995 to 2010. A good range of species records were provided, a total of 27 species. These were predominantly common species, but records for four species of local concern were revealed, including: brown hairstreak records from Bure Park as recently as 2010; records of white-letter hairstreak from the Whitelands Farm area to the south of the proposed development dated 1997, and from habitats along the B4030 Middleton Stoney Road adjacent to the southern portion of the Masterplan site, dating from 2008.

6.4.1.4 The habitats within the site that were of potential value to invertebrates, and which were targeted for survey were the hedgerows, the watercourses and one of the arable field margins that supported areas of longer grass. No legally protected invertebrates were recorded during the surveys. The desk study revealed that there were no nearby records for barberry carpet and no larvae of the barberry carpet moth were identified on either of the targeted site visits. It is therefore considered unlikely that this species is present within the Masterplan site.

6.4.1.5 Eight moth species and one butterfly species of conservation concern (Section 41 NERC Act species) were recorded during the targeted invertebrate surveys these were:

- beaded chestnut (*Agrochola lychnidis*) (Gowell Farm and lane to Lord's Farm);
- green brindled crescent (*Allophyes oxyacanthae*) (lane to Lord's Farm);
- centre-barred sallow (*Atethmia centra*go) (Gowell Farm, lane to Lord's Farm and Crowmarsh Farm woodland);
- small phoenix (*Ecliptoptera silaceata*) (lane to Lord's Farm);
- ghost moth (*Hepialus humuli*) (Gowell Farm);
- dot moth (*Melanchra persicariae*) (Gowell Farm);
- cinnabar moth (*Tyria jacobaeae*) (Gowell Farm);
- sallow (*Xanthia icteritia*) (lane to Lord's Farm); and
- small heath butterfly (Coenonympha pamphilus) (Gowell Farm).

6.4.1.6 Six of these species were recorded in the vicinity of Gowell Farm. Whilst five of the moths were recorded on the tree and shrub-lined lane leading to Lord's Farm. The micro moth *Stigmell samiatella* a Red Data Book species (Refs 6-31 and 6-32) was also recorded in a tree close to Gowell Farm.

6.4.1.7 Five Nationally Scarce (Nationally Notable - Nb) invertebrates were recorded during the invertebrate surveys. These were: the shaded pug moth (*Eupithecia subumbrata*) - recorded on the edge of an arable field to the west of Home Farm; Roesel's bush-cricket (*Metrioptera roeseli*)- also recorded on the edge of the same arable field and on the lane leading to Lord's Farm; the bark beetle (*Kissophagus hederae*) on the lane leading to Lord's Farm; *Phyllonorycter platanoidella* a micro-moth in the vicinity of Gowell Farm; and the blue and red leaf beetle (*Podagica fuscicornis*) also recorded in the vicinity of Gowell Farm. It should be noted that Roesel's bush-cricket has undergone a substantial increase in its range over recent years due to climate change, and is generally now generally considered to be a Nationally Local species rather than Nationally Notable.

6.4.1.8 In addition, 21 Nationally Local invertebrates were recorded during the invertebrate surveys, one of these species a soldier fly (*Oplodontha viridula*) was recorded in Grunthill Copse which is not within the Masterplan site. The habitats around Gowell Farm supported the largest number of these species (11); this is followed by the hedgerows that supported nine of these species; the other parts of the site supported between two and four of these species. The most ubiquitous of the Nationally local species was a leaf beetle (*Aphthona euphorniae*), which was found in all parts of the Masterplan site that were subject to survey. See Appendix 6F for more details.

6.4.1.9 Brown hairstreak eggs were identified during the targeted surveys and suitable habitat for this species (Blackthorn shrubs for egg-laying within the hedgerows and mature trees for display

and mating) was present across the Masterplan site. Elm (*Ulmus* sp.) was recorded in many of the hedgerows in the southern part of the Masterplan site. Given that this is the foodplant of the white-letter hairstreak and the fact that these butterflies have been recorded in hedgerows close to the southern boundary of the Masterplan site it would appear likely that this Section 41 (NERC Act) species would be present within the hedgerows on the Masterplan site.

6.4.1.10 The Masterplan site as a whole comprises habitats with limited structural diversity and limited botanical diversity that consequently support a limited diversity of terrestrial invertebrates. The parts of the site that were of greatest value to invertebrates were the hedgerows, the 'weedy' habitats associated with Gowell Farm and the more mature trees and shrubs associated with the access track leading to Lord's Farm.

## 6.5 Fish

6.5.1.1 Although targeted surveys for fish were not undertaken a shoal of roach (*Rutilus rutilus*) were noted within the southern pond associated with Himley Farm (Pond 15 on Drawing 6-2). Three-spined stickleback (*Gastreosteus aculeatus*) were also recorded in Crowmarsh pond (P6 on Drawing 6-2). Fish species recorded incidentally during the aquatic invertebrate surveys of the River Bure included three-spined stickleback, ten-spined stickleback (*Pungitius pungitius*), and Bullhead (*Cottus gobio*); a species associated with good water quality for which a Special Area of Conservation can be designated under the Habitats Directive.

## 6.6 Great crested newts

6.6.1.1 A medium population of great crested newts were found to be present within the ponds associated with Himley Farm, within the Masterplan site boundary; these are ponds P14 and P15 on Drawing 6-2.

6.6.1.2 A population of great crested newts was also found to be present within four ponds at Bucknell, outside the Masterplan site boundary; Ponds 2, 5, 7 and 9 on Drawing 6-2. Ponds P2, P5 and P9 are over 500 metres from the Masterplan site boundary and it is considered unlikely that the great crested newts associated with these ponds would forage within the Masterplan site. Pond P7 is 240m from the western boundary of the Masterplan site. Great crested newts typically forage within 250 metres of their breeding pond, therefore there is the potential that newts associated with this pond may forage within suitable habitat (in this case the bases of the hedgerows) on the edge of the Masterplan site. The arable fields on the edge of the Masterplan site represented sub-optimal habitat for foraging newts and as such it is extremely unlikely that these fields would be of value to these newts.

6.6.1.3 Great crested newts are known to breed in a pond on Bure Park. However, it is considered unlikely that these newts would forage on the Masterplan site since the pond is over 300 m from the Masterplan site boundary and separated from the site by residential development and Lord's Lane.

6.6.1.4 Great crested newts were absent from the other five ponds that were subject to survey. Great crested newts are a Section 41 (NERC Act) species; individual great crested newts, their breeding sites and resting sites receive full protection under UK and European legislation. The HSI scores and pond descriptions are presented in Appendix 6G.

6.6.1.5 Smooth newts (*Lissotriton vulgaris*) and/or common frog (*Rana temporaria*) were recorded within 11 ponds (P1, P2, P3, P5, P6, P7, P9, P10, P13, P14 and P15 on Drawing 6-2). Common toad (*Bufo bufo*) a Section 41 (NERC Act) species was not recorded on site during the surveys and it would appear that they do not breed within any of the features that were

surveyed. Common toad more typically breed in deep/ large water bodies that were not present within the Masterplan site.

## 6.7 Reptiles

6.7.1.1 The targeted surveys for reptiles revealed the presence of small numbers of common lizards (*Zootaca vivipara*) within suitable habitats across the site, including the western boundary of the site, the railway embankment, Crowmarsh pond, Gowell Farm, in a strip of ruderal vegetation parallel with Howes Lane and on a field margin south of Aldershot Farm. Their presence was also confirmed from direct observation during the walkover surveys of the farmland around Himley Farm. The maximum count on any single visit was a single adult and three juvenile common lizards at two separate locations. It is considered likely that small numbers of common lizard would be present in other areas of suitable habitat (the unmanaged field margins and stream corridors) across the Masterplan site.

6.7.1.2 There are historical records for grass snake (*Natrix natrix*) at Himley Farm (dating from 1995 and 2003) and a grass snake was recorded on the northern boundary of the woodland to the west of Home Farm. It is considered likely that grass snakes would be present in other areas of suitable habitat, in particular, within the areas of grassland adjacent to the ponds and watercourses. Few areas of habitat suitable for use by slow-worm (*Anguis fragilis*) were recorded within the Masterplan site. There was very little tussocky grassland and scrub and the woodlands represented sub-optimal habitat for this species. The railway embankment represented suitable habitat and it is likely that the south facing bank, at least, would support slow-worms, assuming that they are present in the locality (the desk study did not reveal any records for slow-worms).

6.7.1.3 All three common species of reptile are identified as species of Principal Importance under Section 41 of the NERC Act. They are also protected under UK legislation.

## 6.8 Breeding birds

6.8.1.1 One legally protected bird species, barn owl, has been recorded nesting within the Masterplan site. Barn owls have nested in specifically designed barn owl nest boxes located on trees to the west of Home Farm. Two boxes were relocated in 2013 to the edge of the Masterplan site to ensure that nesting barn owls are not disturbed by the construction works associated with consented Eco development within the Exemplar site or subsequent development associated with the wider Masterplan. At the time that the boxes were moved one contained barn owl remains. Barn owl pellets were also found within one of the barns at Himley Farm; however, their nest box had been removed in advance of the 2011 survey. There was no evidence that barn owl used other suitable features within the other out-buildings associated with Himley Farm. Barn owls are specially protected under Schedule 1 of the Wildlife and Countryside Act.

6.8.1.2 Eleven species of birds of conservation concern (BOCC Red list) (Ref 6-22) and species of Principal Importance under Section 41 of the NERC Act were found to be nesting or identified as probable nesting on or close to the Masterplan site in the surveys undertaken in 2010. These were:

- skylark (*Alauda arvensis subsp. arvensis*), 15 pairs associated with the arable fields;
- linnet (*Carduelis cannabina subsp. autochthona/cannabina*), 14 pairs associated with the hedgerows;
- cuckoo (*Cuculus canorus*), at Gowell Farm;

- yellowhammer (*Emberiza citrinella*), 44 pairs associated with hedgerows across the Masterplan site;
- yellow wagtail (*Motacilla flava subsp. flavissima*), one pair at Crowmarsh Farm;
- spotted flycatcher (*Muscicapa striata*) in a shed near Lower Farm in Bucknell outside the Masterplan site;
- marsh tit (*Poecile palustris subsp. palustris/dresseri*), one pair in woodland west of Home Farm;
- starling (*Sturnus vulgaris*), three pairs associated with trees and farm building;
- songthrush (*Turdus philomelos subsp. clarkei*), 16 pairs associated with the hedgerows;
- lapwing (*Vanellus vanellus*), two pairs in fields beyond the Masterplan site boundary; and
- house sparrow (*Passer domesticus*), 7 pairs associated with the farm buildings.

6.8.1.3 The 2011 surveys of the land around Himley Farm revealed that within this part of the Masterplan site, four species of Birds of Conservation Concern (BOCC Red list) (Ref 6-22) and Section 41 (NERC Act) species were found to be nesting or probable nesting. These were: 13 pairs of skylark; 14 pairs of linnet; one pair of song thrush and 24 pairs of yellowhammer.

6.8.1.4 Ten species listed on the BOCC Amber list (Ref 6-22) were also recorded in the 2010 surveys:

- stock dove (*Columba oenas*), two pairs Crowmarsh Farm;
- reed bunting (*Emberiza schoeniclus*), one pair Crowmarsh pond;
- kestrel (*Falco tinnunculus*), one pair west of Home Farm;
- swallow (*Hirundo rustica*) , 11 pairs associated with farm buildings;
- green woodpecker (*Picus viridis*) two pairs were recorded one by Hawkwell Farm and one by Lord's Farm;
- willow warbler (*Phylloscopus trochilus*), four pairs;
- dunnock (*Prunella modularis* subsp. *occidentalis*), 39 pairs;
- bullfinch (*Pyrrhula pyrrhula* subsp. *pileata*), seven pairs;
- common whitethroat (*Sylvia communis*), 37 pairs; and
- mistlethrush (*Turdus viscivorus*), one pair Aldershot Farm.

6.8.1.5 Dunnock, bullfinch and reed bunting are also Section 41 NERC Act species. Two pairs of dunnock and up to 12 pairs of whitethroat were recorded in the land around Himley Farm in 2011. Other BOCC Amber list species that were recorded around Himley Farm in 2011 included mallard (*Anas platyrhynchos*), stock dove (*Columba oenas*), swallow (*Hirundo rustica*), herring gull *(Larus argentatus*) and wheatear (*Oenanthe oenanthe*). The latter two species were not breeding within the Masterplan site.

6.8.1.6 In addition, the desk study also revealed records for two BOCC Red list and Section 41 NERC Act species within the Masterplan site in previous years. These were: corn bunting (*Emberiza calandra subsp. calandraon*), a pair of which nested on the site in 2007; and grey partridge (*Perdix perdix*), which were re-introduced to the site in 2010. Neither of these species were recorded during the 2010 and 2011 breeding bird surveys. A list of the birds recorded during the 2010 and 2011 surveys, together with their conservation status is presented in Appendix 6H.

## 6.9 Wintering birds

6.9.1.1 The wintering bird surveys showed moderate numbers of yellowhammer (flocks of up to 150), skylark (flock of up to 24), redwing (flocks up to 50) and fieldfare (flocks of up to 150). Low to moderate numbers of other bird species of conservation concern that were recorded during the surveys included:

- Mallard (two birds);
- linnet (up to 40 birds);
- reed bunting (three birds);
- kestrel (single birds);
- herring gull (*Larus argentatus*) (single birds recorded flying over the site);
- red kite (*Milvus milvus*) (single birds recorded flying over the site);
- marsh tit (two birds);
- house sparrow (up to twelve birds);
- grey partridge (two birds);
- green woodpecker (one bird);
- dunnock (21 birds);
- bullfinch (up to five birds);
- starling (usually small flocks but a flock of up to 100 birds were recorded on one occasion);
- song thrush (up to three birds); and
- a flock of 100 lapwing flew over the site.

6.9.1.2 The distribution of wintering birds reflected the field and hedgerow management, with stubble fields and the less heavily trimmed hedgerows supporting higher numbers. No barn owls were recorded within the Masterplan site during the surveys. A list of the birds recorded during the 2011 wintering bird surveys, together with their conservation status is presented in Appendix 6I.

6.9.1.3 As identified above, red kite (a species specially protected under Schedule 1 of the Wildlife and Countryside Act, whilst breeding) were observed flying over the site during the wintering bird surveys; but they were not recorded nesting on the Masterplan site during the breeding bird surveys. It is considered unlikely that red kite would nest within the small woodlands that are

present within the Masterplan site since they require large trees for nesting, which are absent from the Masterplan site. Similarly, although both fieldfare and redwing are listed on Schedule 1 of the Wildlife and Countryside Act, and therefore specially protected whilst nesting, and both were recorded on site during the wintering bird surveys, neither species would breed within the Masterplan site since they do not breed in southern Britain.

6.9.1.4 Eleven BOCC Red list (Ref 6-22) species were recorded overwintering within the Masterplan site: skylark, linnet, yellowhammer, herring gull, marsh tit, house sparrow, grey partridge, starling, redwing, song thrush and lapwing. Skylark, linnet, yellowhammer, herring gull, marsh tit, house sparrow, grey partridge, starling, song thrush and lapwing are also species of Principal Importance (Section 41 NERC Act species) as are reed bunting and dunnock which as identified previously were also recorded during the wintering bird surveys.

## 6.10 Bats

6.10.1.1 The desk study revealed records for common pipistrelle (*Pipistrellus pipistrellus*), brown long-eared and Natterer's bat (*Myotis nattereri*) within 5km of the Masterplan site. There are also known common pipistrelle and brown long-eared bat roosts approximately 2km south of the Masterplan site. The known roosts for Leisler's bat (*Nyctalus leisleri*) and serotine (*Eptesicus serotinus*) are greater than 10km from the Masterplan site.

6.10.1.2 The Arup surveys identified 28 trees within the Masterplan site as potentially suitable for use by roosting bats; but none of the trees within the land around Himley Farm contained features suitable for use by roosting bats (most were too young to contain suitable crevices or holes).

6.10.1.3 Targeted emergence surveys were undertaken in 2010 to confirm the use of these trees by roosting bats. Both hand-held and automatic bat detectors (Anabats) were used to determine the presence/absence of bats within these trees. As identified in paragraph 5.1.1 (limitations and assumptions) the automatic bat detectors that were located outside three trees failed to operate on two of the three occasions that they were deployed. It is therefore possible that these trees do support roosting bats. However, it is considered unlikely that these trees support large or significant roosts since these would have been detected during the activity surveys.

6.10.1.4 The presence of roosting bats was confirmed in two trees within the Masterplan site both were in the northern half of the site; their locations are shown on Drawing 6-3, they comprise:

- A small common pipistrelle bat roost within an artificial bat roosting box on a mature tree along the River Bure to the south-west of Home Farm (within the consented Eco development site); and
- Small numbers of common pipistrelle bats within a mature Ash tree on the edge of the woodland to the west of Home Farm.

6.10.1.5 The level of bat activity that was recorded close to the two mature trees on the watercourse south of Hawkwell Farm may indicate that these trees could support a common pipistrelle roost. Similarly, the levels of bat activity close to Crowmarsh Farm indicate that bats may roost in the trees or buildings close to this property.

6.10.1.6 A number of the buildings within the Masterplan site were identified as containing features potentially suitable for use by roosting bats. These included the buildings associated with Home Farm; Hawkwell Farm; Gowell Farm; Crowmarsh Farm; Aldershot Farm and Himley Farm. In addition the bungalow to the south of Himley Farm known as Lovelynch House and the farmhouse associated with Lord's Farm also contained features potentially suitable for use by roosting bats.

6.10.1.7 The surveys revealed:

- A bat roost used by small numbers of common pipistrelle bats within a modern farmhouse at Home Farm;
- A bat roost used by small numbers of common pipistrelle bats within a barn at Himley Farm; the landowner identified that previously this barn has supported a brown long-eared bat roost but no evidence of use by this species was recorded during any of the surveys;
- Five or more common pipistrelle bats were recorded close to the buildings associated with Lord's Farm shortly after dusk. This indicates that the buildings may support a bat roost, although its location was not confirmed during the surveys;
- The level of bat activity associated Crowmarsh Farm may also indicate that these buildings support a pipistrelle and/or *Myotis* bat roost, but once again the surveys were inconclusive; and
- Although access to Lovelynch House was not provided the activity surveys did not reveal large numbers of bats appearing close to this property shortly after dusk. It would appear, therefore, that the property does not support a large or significant roost.

6.10.1.8 In addition, three roosts were confirmed outside of the Masterplan site boundary as follows. These are shown on Drawing 6-3:

- Individual common pipistrelle bats within two adjacent mature oak trees;
- A roost of brown long-eared bats and other unconfirmed species within St Laurence Church, Caversfield.

6.10.1.9 The majority of the bat activity was associated with the stream corridors and largely comprised foraging and commuting common pipistrelle bats, but regular activity of soprano pipistrelle, brown long-eared, serotine, noctule, Leisler's and *Myotis* species were also recorded. A single Narthusius' pipistrelle (*Pipistrellus nathusii*) was recorded close to Crowmarsh pond. A number of hedgerows were also revealed to be key features for foraging and commuting bats.

6.10.1.10 The activity surveys that were undertaken in the land around Himley Farm revealed that small numbers of common and soprano pipistrelle (*Pipistrellus pygmaeus*) bats were foraging along the hedgerows, other bats recorded included noctule (*Nyctalus noctula*) and *Myotis*. Although no distinct commuting routes were recorded across this part of the Masterplan site, it would be appropriate to maintain corridors of vegetation suitable for use by commuting bats in order that bats roosting nearby can cross the site to access suitable foraging habitat to the south and west of the land around Himley Farm.

6.10.1.11 All bat species are fully protected under UK and European legislation. In addition, soprano pipistrelle, brown long-eared bat and noctule are Section 41 (NERC Act) species of Principal Importance.

## 6.11 Dormice

6.11.1.1 No evidence of dormice was found during the targeted surveys undertaken within the Masterplan site. No records of this species were obtained from TVERC and the links between the site and suitable habitat within the wider area were limited. It is therefore considered that dormice are absent from the Masterplan site.

## 6.12 Water voles

6.12.1.1 There are records dating from 2003 for water voles on the River Bure downstream of the Masterplan site. However, the only suitable habitat for water voles within the Masterplan site was the upstream extent of the tributary of the River Bure near Crowmarsh Farm. This section of watercourse supported vegetated clay banks and appeared to have good water quality; however, no signs of water vole activity were recorded in this location during the surveys. Within the Masterplan site, the River Bure was heavily shaded by trees and shrubs and largely lacked any emergence vegetation suitable for foraging water voles. Whilst unshaded sections of the tributaries contained areas of suitable vegetation, these watercourses were largely dry throughout the spring and summer months, and therefore, at best, sub-optimal for use by water voles. Given the isolated nature, and the limited extent of suitable habitat it is considered unlikely that the tributaries of the River Bure supports water voles and no signs of water vole activity were recorded during the targeted surveys. Water voles are therefore considered to be absent from the Masterplan site, but have the potential to colonise the site in future if suitable habitat were created that is sufficiently close to extant populations.

## 6.13 Otters

6.13.1.1 There are records for otters in the locality, with spraint recorded close to the fishery at Trow Pool. Trow Pool is 1.7km west of the Masterplan site boundary and not linked to the Masterplan site by a watercourse. The River Bure and its tributaries provided cover for otters and it is considered likely that otters would use these features whilst travelling across their home range. However, within the Masterplan site, the tributaries appeared to hold very little water for most of the year and the River Bure appeared to support few fish and other prey items suitable for otters. It is therefore considered that these features would be of limited value to foraging otters. The tree and shrub lined banks did provide suitable resting sites for otters, but no signs of otter activity were recorded during the survey.

6.13.1.2 Based on the survey data and conditions on the site, the Masterplan site is considered to be of limited value to otters. However, Otters are a highly mobile species, it is considered appropriate to ensure that otters are able to travel along the watercourses within the Masterplan site to enable them to gain access to more valuable habitats within their range. Otters are fully protected under UK and European legislation; they are also a species of Principal Importance (NERC Act Section 41 species).

## 6.14

6.14.1.1

6.14.1.2

## 6.15 Other mammals of conservation concern

6.15.1.1 Records were provided for brown hare in the locality and small numbers of brown hare were recorded within the Masterplan site. Whilst there are no records for hedgehog (*Erinaceus europaeus*), polecat (*Mustela putorius*) and harvest mouse (*Micromys minutus*) in close proximity to the Masterplan site, records were provided for hedgehog and polecat in the locality. It is likely that hedgehogs would forage across the Masterplan site, most likely in association with the hedgerows and other linear features. The Masterplan site comprised habitats that are sub-optimal for polecat which is more typically associated with woodland areas. Harvest mouse (*Micromys minutus*) could be present within the hedgerows associated with the Masterplan site. However, given that the intensity of the management of the arable fields and grasslands the site is considered to be sub-optimal for this species. In England, hedgehog, polecat and harvest mouse are all species of Principal Importance (NERC Act Section 41 species).

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# Appendix 6B Botanical data (Woodland)

## Home Farm Wood W8d

| | |
|---|---|
| **Survey date:** 28th July 2010 | **Description of Sample Site:**<br>Replanted wood with some remaining ash in the canopy, stumps and felled trunks. Sparse leaf litter and few areas of bare ground due to extensive moss cover. |
| **Altitude:** 90m | **Slope:**Level |
| **Aspect:** None | **Soil:** silty-clay |
| **Stand Area:** 300m × 80m | **Sample Area:**<br>Canopy 50 x 50m, understorey 10 x 10m, field layer 4m x 4m and ground layer 1m x 1m |
| **Layers (Mean Height)**<br>Canopy 20m<br>Understorey 8m<br>Field 1m<br>Ground 50mm | **Layers (Cover)**<br>Canopy 40%<br>Understorey 70%<br>Field 50%<br>Ground 80% |

| **Plant Species** | **1** | **2** | **3** | **4** | **5** | **Plant Species** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Canopy** | | | | | | **Field Layer** | | | | | |
| *Acer campestre* | | | 3 | 6 | | *Fraxinus excelsior* | 2 | 4 | 2 | | |
| *Fraxinus excelsior* | 5 | 5 | 5 | 4 | 5 | *Geum urbanum* | 2 | | | | |
| **Understorey** | | | | | | *Glechoma hederacea* | 3 | | 3 | | 2 |
| *Acer campestre* | | | | 2 | 4 | *Hedera helix* | | | 4 | 7 | 8 |
| *Corylus avellana* | | 2 | | | | *Mercurialis perennis* | 7 | 5 | 5 | 3 | 4 |
| *Crataegus monogyna* | 5 | 8 | | | 5 | *Rosa canina* | | | | | 1 |
| *Sambucus nigra* | 7 | 3 | 7 | 4 | 3 | *Rubus fruticosus* agg. | 2 | | | | |
| *Ulmus procera* | | 2 | | | | *Sambucus nigra* | | | 2 | | |
| **Field Layer** | | | | | | **Stachys sylvatica** | | | | | **2** |
| *Alliara petiolata* | | | | | 2 | *Tamus communis* | | | | | 1 |
| *Anthriscus sylvestris* | | 5 | 6 | 6 | 7 | *Urtica dioica* | 5 | 4 | 5 | 2 | 3 |
| *Arctium lappa* | 1 | | | | | *Viola riviniana/reichenbachiana* | | | 2 | | |
| *Arum maculatum* | 2 | 2 | 2 | 2 | 2 | **Ground Layer** | | | | | |
| *Bromopsis ramosa* | | | | 2 | 3 | *Hypnum cupressiforme* | 2 | 2 | | 1 | |
| *Dryopteris dilatata* | | | 1 | | | *Thamnobryum alopecurum* | 6 | 8 | 4 | 6 | 2 |

# Hawkwell Farm Wood W8e

| | |
|---|---|
| **Survey date:** 30th July 2010 | **Description of Sample Site:** Ash woodland partially planted with grey poplar. The wood is adjacent to a stream and is subject to flooding. |
| **Altitude:** 83m | **Slope:** Level |
| **Aspect:** None | **Soil:** Silty-clay |
| **Stand Area:** 250m × 60m | **Sample Area:** Canopy 50 x 50m, understorey 10 x 10m, field layer 4m x 4m and ground layer 1m x 1m |
| **Layers (Mean Height)**<br>Canopy 23m<br>Understorey 7m<br>Field 1m<br>Ground 50mm | **Layers (Cover)**<br>Canopy 85%<br>Understorey 75%<br>Field 50%<br>Ground 80% |

| **Plant Species** | **1** | **2** | **3** | **4** | **5** | **Plant Species** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Canopy** | | | | | | **Field Layer** | | | | | |
| *Fraxinus excelsior* | 3 | 3 | 4 | 7 | 8 | *Deschampsia flexuosa* | | | | 1 | |
| *Populus × canescens* | 8 | 8 | 7 | 3 | | *Fraxinus excelsior* | | | | 1 | 1 |
| **Understorey** | | | | | | *Galium aparine* | | | | 2 | |
| *Acer campestre* | 3 | 3 | 3 | 2 | 2 | *Geranium robertianum* | 3 | 2 | 3 | 4 | 5 |
| *Crataegus monogyna* | 6 | 5 | 6 | 6 | 5 | *Geum urbanum* | 2 | | | | |
| *Fraxinus excelsior* | 3 | 3 | 4 | 4 | 5 | *Melica uniflora* | 2 | | | | |
| *Ilex aquifolium* | | *2* | *1* | | | *Mercurialis perennis* | 5 | 5 | 5 | 6 | 6 |
| *Ligustrum vulgare* | 5 | 4 | 3 | 3 | 2 | *Ribes rubrum* | | | *2* | *4* | *4* |
| *Populus × canescens* | 3 | 4 | 2 | | | *Rubus fruticosus* agg. | 3 | 3 | 2 | | 2 |
| *Rosa canina* | 2 | 2 | | | | *Stachys sylvatica* | | 2 | 2 | 2 | 2 |
| *Sambucus nigra* | 1 | | | 4 | 3 | *Tamus communis* | 3 | | | | |
| *Ulmus procera* | 4 | 4 | 4 | | 1 | *Urtica dioica* | | 3 | 3 | 5 | 4 |
| **Field Layer** | | | | | | **Ground Layer** | | | | | |
| *Ajuga reptans* | | | 3 | 3 | 3 | *Hedera helix* | 6 | 6 | 7 | 6 | 8 |
| *Arum maculatum* | | 2 | 3 | 3 | 3 | *Eurhynchium striatum* | 2 | 3 | 2 | | |
| *Bromopsis ramosa* | 4 | 3 | 3 | 1 | 2 | *Kindbergia praelonga* | 3 | 7 | 5 | 6 | 4 |
| *Carex sylvatica* | 3 | 2 | 2 | 3 | 2 | | | | | | |
| *Circaea lutetiana* | 4 | 4 | 5 | | | | | | | | |

# Appendix 6C Botanical data (Grassland)

## Hawkwell Farm Grassland MG7e

| | |
|---|---|
| **Survey date:** 30th July 2010 | **Description of Sample Site:** Cattle grazed pasture adjacent to a stream and subject to flooding. |
| **Altitude:** 83m | **Slope:** Level |
| **Aspect:** None | **Soil:** silty-clay |
| **Stand Area:** 600m x 50m | **Sample Area:** 2m x 2m |

| **Plant Species** | **1** | **2** | **3** | **4** | **5** | **Plant Species** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Agrostis capillaris* | 5 | 5 | 4 | 3 | 3 | *Poa pratensis* | 5 | 4 | 3 | | 4 |
| *Agrostis stolonifera* | | | | 1 | 1 | *Ranunculus repens* | | | | 4 | 3 |
| *Brachythecium rutabulum* | | | | 1 | 3 | *Rumex crispus* | 1 | | | | |
| *Cirsium arvense* | | 1 | | | 1 | *Rumex obtusifolius* | | | | | 1 |
| *Dactylis glomerata* | 4 | 4 | 3 | 3 | 3 | *Taraxacum officinale* agg. | | | | 1 | 2 |
| *Festuca rubra* | 5 | 5 | 5 | 4 | 4 | *Trifolium repens* | | | | 2 | |
| *Holcus lanatus* | 6 | 5 | 5 | 5 | 5 | *Urtica dioica* | 1 | | 1 | | |
| *Lolium perenne* | 6 | 5 | 5 | 5 | 4 | | | | | | |
| *Plantago major* | | | | | 1 | | | | | | |

## Home Farm Grassland MG7d (Field 1)

| **Survey date:** 30th July 2010 | | | | | | **Description of Sample Site:** Cattle grazed pasture adjacent to a stream and subject to flooding. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Altitude:** 90m | | | | | | **Slope:** Level | | | | | |
| **Aspect:** None | | | | | | **Soil:** silty-clay | | | | | |
| **Stand Area:** 260m x 90m | | | | | | **Sample Area:** 2m x 2m | | | | | |
| **Plant Species** | **1** | **2** | **3** | **4** | **5** | **Plant Species** | **1** | **2** | **3** | **4** | **5** |
| *Agrostis capillaris* | 3 | 4 | 3 | 2 | 2 | *Juncus inflexus* | | | 3 | 4 | |
| *Agrostis stolonifera* | 2 | 1 | 2 | | | *Lolium perenne* | | | | | 2 |
| *Bromus hordeaceus* | | 2 | | | | *Phleum pratense* | 1 | | | | |
| *Cardamine pratensis* | | | 2 | 1 | | *Poa pratensis* | 2 | | | | |
| *Carex hirta* | | | 2 | 4 | 1 | *Potentilla reptans* | 2 | 1 | | | |
| *Dactylis glomerata* | | 2 | | | 1 | *Ranunculus repens* | | 2 | 2 | 1 | |
| *Deschampsia cespitosa* | | | | 2 | 4 | *Rumex acetosa* | 2 | 1 | | 1 | |
| *Epilobium hirsutum* | | | 2 | 1 | | *Sonchus oleraceus* | 1 | | 1 | 1 | |
| *Festuca pratensis* | 2 | 2 | 2 | 1 | 1 | *Taraxacum officinale* agg. | 2 | | | 1 | 2 |
| *Festuca rubra* | 4 | 3 | 3 | 3 | 3 | | | | | | |
| *Holcus lanatus* | 3 | 4 | 5 | 4 | 3 | | | | | | |

## Home Farm Grassland MG7d (Field 2)

| **Survey date:** 28th July 2010 | | | | | | **Description of Sample Site:** Cattle grazed pasture adjacent to a stream and subject to flooding. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Altitude:** 90m | | | | | | **Slope:** Level | | | | | |
| **Aspect:** None | | | | | | **Soil:** silty-clay | | | | | |
| **Stand Area:** 260m x 50m | | | | | | **Sample Area:** 2m x 2m | | | | | |
| **Plant Species** | **1** | **2** | **3** | **4** | **5** | **Plant Species** | **1** | **2** | **3** | **4** | **5** |
| *Agrostis capillaris* | 3 | 3 | 4 | 2 | 3 | *Juncus effusus* | | | | | 1 |
| *Agrostis stolonifera* | 1 | 1 | 2 | | 1 | *Juncus inflexus* | | | | 3 | 3 |
| *Anthoxanthum odoratum* | 2 | 2 | 3 | | 2 | *Lolium perenne* | 2 | 1 | | | |
| *Cirsium arvense* | 1 | 1 | | | | *Ranunculus repens* | 2 | 1 | | | |
| *Dactylis glomerata* | 3 | 2 | | | | *Rumex acetosa* | | | | 1 | 2 |
| *Deschampsia cespitosa* | 4 | 2 | 3 | 4 | | *Rumex obtusifolius* | | | | | 2 |
| *Equisetum arvense* | 2 | | | | | *Taraxacum officinale* agg | | | | 1 | 3 |
| *Festuca pratensis* | 3 | 4 | 2 | 2 | | | | | | | |
| *Festuca rubra* | 5 | 4 | 3 | 2 | 4 | | | | | | |

## Home Farm Grassland MG7c (Field 3)

| **Survey date:** 28th July 2010 | | | | | | **Description of Sample Site:** Cattle grazed pasture adjacent to a stream and subject to flooding. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Altitude:** 88m | | | | | | **Slope:** Level | | | | | |
| **Aspect:** None | | | | | | **Soil:** silty-clay | | | | | |
| **Stand Area:** 240m x 60m | | | | | | **Sample Area:** 2m x 2m | | | | | |
| **Plant Species** | **1** | **2** | **3** | **4** | **5** | **Plant Species** | **1** | **2** | **3** | **4** | **5** |
| *Agrostis capillaris* | 3 | 4 | 2 | 2 | 2 | *Hordeum secalinum* | | | | 2 | 2 |
| *Alopecurus pratensis* | 3 | 1 | | | | *Leontodon autumnalis* | | 2 | | 1 | |
| *Arrhenatherum elatius* | 4 | 4 | | | | *Lolium perenne* | 3 | 2 | 4 | 4 | 4 |
| *Brachythecium rutabulum* | | | | 1 | 2 | *Phleum pratense* | | | | | 1 |
| *Bromus hordeaceus* | | 2 | 2 | | | *Potentilla reptans* | | | | 3 | |
| *Convolvulus arvensis* | | 3 | | | 2 | *Rumex acetosa* | | | | | 1 |
| *Dactylis glomerata* | 4 | 4 | 1 | 4 | 3 | *Rumex obtusifolius* | | | 1 | | |
| *Deschampsia cespitosa* | | | | 1 | | *Taraxacum officinale* agg | | | | 1 | 1 |
| *Festuca pratensis* | | | 4 | 1 | 1 | *Trifolium pratense* | 2 | | | | |
| *Festuca rubra* | 5 | 4 | 4 | 4 | 4 | *Urtica dioica* | | | | 1 | 1 |
| *Holcus lanatus* | | | | 3 | 1 | | | | | | |

# Appendix 6D Botanical data (Hedgerows)

Woody species recorded in 30 metre sample of hedgerow during Arup surveys in 2010.

| **Hedgerow Number** | Apple, crab | Ash | Alder Buckthorn | Blackthorn | Cherry, wild | Dogwood | Elder | Elm | Guelder-rose | Hawthorn | Hazel | Holly | Maple, field | Oak | Privet, Wild | Rose | Sycamore | Wayfaring-tree | Willow | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | ✓ | | ✓ | | | ✓ | ✓ | | ✓ | | | | | ✓ | ✓ | ✓ | | | ✓ |
| 2 | | | | ✓ | ✓ | | | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | ✓ | | ✓ | |
| 3 | | ✓ | | ✓ | | | | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | | | | |
| 4 | | ✓ | | | | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | | | | | |
| 5 | | ✓ | | ✓ | | | ✓ | ✓ | | ✓ | | | | | ✓ | ✓ | | | | |
| 6 | ✓ | ✓ | | ✓ | | | | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | | |
| 7 | | | | | | | ✓ | | | ✓ | | | | | | ✓ | | | | |
| 8 | | ✓ | | ✓ | | ✓ | ✓ | ✓ | | ✓ | | | | | ✓ | ✓ | | | | |
| 9 | | | ✓ | ✓ | | | ✓ | ✓ | | ✓ | | | | | | ✓ | ✓ | | | |
| 10 | | ✓ | | | | | ✓ | ✓ | | ✓ | | | | | ✓ | ✓ | ✓ | | | |
| 11 | | | | | | | ✓ | | | ✓ | | | ✓ | | ✓ | ✓ | | | | |
| 12 | | | | ✓ | | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | | ✓ | | ✓ | | |
| 13 | | ✓ | | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | | ✓ | ✓ | |
| 14 | ✓ | ✓ | | ✓ | | | ✓ | | | ✓ | | | ✓ | | ✓ | ✓ | | ✓ | | |
| 15 | | | | ✓ | | ✓ | | | | ✓ | | | ✓ | | ✓ | ✓ | | | ✓ | |
| 16 | | ✓ | | ✓ | | ✓ | | | | ✓ | | | ✓ | | ✓ | ✓ | | ✓ | ✓ | |
| 17 | | | | ✓ | | ✓ | ✓ | | | ✓ | | | ✓ | | ✓ | | | | | |
| 18 | | ✓ | ✓ | ✓ | | | ✓ | ✓ | | ✓ | | | | | | ✓ | | | | |
| 19 | | | | ✓ | | | ✓ | ✓ | | ✓ | ✓ | | ✓ | | ✓ | ✓ | | ✓ | | |
| 20 | | ✓ | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | ✓ | | | |
| 21 | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 22 | | | | ✓ | | | ✓ | ✓ | | ✓ | | | | | ✓ | ✓ | | | | |

| Hedgerow Number | Apple, crab | Ash | Alder Buckthorn | Blackthorn | Cherry, wild | Dogwood | Elder | Elm | Guelder-rose | Hawthorn | Hazel | Holly | Maple, field | Oak | Privet, Wild | Rose | Sycamore | Wayfaring-tree | Willow | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | ✓ | | | ✓ | | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | | | | ✓ | |
| 24 | ✓ | ✓ | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | | ✓ | | | | |
| 25 | ✓ | ✓ | | ✓ | | | ✓ | ✓ | | ✓ | ✓ | | ✓ | | | ✓ | | | | |
| 26 | ✓ | ✓ | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | | ✓ | | | | |
| 27 | | ✓ | | ✓ | | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | | ✓ | | ✓ | | ✓ |
| 28 | | ✓ | | ✓ | | ✓ | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | | | |
| 29 | ✓ | | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | ✓ | | ✓ | | | | |
| 30 | | | | ✓ | | | ✓ | | | ✓ | | | | | | | | | | |
| 31 | | | | ✓ | | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | | ✓ | |
| 32 | | ✓ | | | | | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | | | | | ✓ |
| 33 | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | | ✓ | | ✓ | | |
| 34 | | | ✓ | ✓ | | | | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | | ✓ | | |
| 35 | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | ✓ | ✓ | | |
| 36 | | ✓ | ✓ | | | | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | ✓ | | | |
| 37 | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | | | | | |
| 38 | | ✓ | ✓ | ✓ | | ✓ | | | | ✓ | | | | | ✓ | ✓ | | | | |
| 39 | | ✓ | ✓ | ✓ | | | ✓ | | | ✓ | | | ✓ | | | ✓ | | | | |
| 40 | ✓ | ✓ | ✓ | | | | ✓ | | | ✓ | | | | | ✓ | ✓ | | ✓ | | |
| 41 | | | ✓ | | | | | | | ✓ | | | | | | | | | | |
| 42 | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | | | | | |
| 43 | ✓ | | ✓ | ✓ | | ✓ | ✓ | | | ✓ | | | | | | ✓ | | | | |
| 44 | | | ✓ | | | | | ✓ | | ✓ | | | | | | ✓ | | | | |
| 45 | | | ✓ | ✓ | | | | | | ✓ | | | ✓ | | | ✓ | | | | |
| 46 | | | | | | | ✓ | | | ✓ | | | | ✓ | | | | | | |

| Hedgerow Number | Apple, crab | Ash | Alder Buckthorn | Blackthorn | Cherry, wild | Dogwood | Elder | Elm | Guelder-rose | Hawthorn | Hazel | Holly | Maple, field | Oak | Privet, Wild | Rose | Sycamore | Wayfaring-tree | Willow | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 47 | ✓ | | ✓ | ✓ | | | ✓ | | | ✓ | | | | | | ✓ | | | | |
| 48 | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | | | |
| 49 | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ | | |
| 50 | | ✓ | ✓ | | | | ✓ | | | ✓ | | | ✓ | | ✓ | ✓ | | | | |
| 51 | | | ✓ | | | | ✓ | | | ✓ | ✓ | | ✓ | | ✓ | ✓ | | ✓ | ✓ | |
| 52 | | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | | | ✓ | | ✓ | ✓ | | | | |
| 53 | | | ✓ | | | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | | ✓ | | ✓ | | |
| 54 | | ✓ | ✓ | | | | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | | | | | |
| 55 | ✓ | ✓ | ✓ | | | | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | | | | | |
| 56 | | | ✓ | | | ✓ | ✓ | | | ✓ | | | ✓ | | | | | ✓ | | |
| 57 | | | ✓ | | | | ✓ | ✓ | | ✓ | | | ✓ | | | | | | | |
| 58 | | | ✓ | | | ✓ | ✓ | | | ✓ | | | | | | | | | | |
| 59 | | | ✓ | | | ✓ | ✓ | | | ✓ | | | ✓ | | ✓ | ✓ | | ✓ | | |
| 60 | | ✓ | ✓ | | | | ✓ | | | ✓ | | | | | | | | | ✓ | |
| 61 | | | | | | | ✓ | | | ✓ | | | | | | | | | | |
| 62 | ✓ | | ✓ | | | ✓ | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | | |
| 63 | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | | | | |
| 64 | ✓ | | | | | | ✓ | ✓ | | ✓ | | | | | | | | | | |
| 65 | | | | | | | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | | | | |

| Associated features | Hedgerow number |
|---|---|
| Bridleway | 8,10,33,35,36,37,38,48,49,50,51 |
| Historic civic boundary | 23,26,64 |

| Hedgerow Number | HEGS Value | Important hedgerows | Hedgerow Number | HEGS Value | Important hedgerows | Hedgerow Number | HEGS Value | Important hedgerows |
|---|---|---|---|---|---|---|---|---|
| 1 | Moderate – High | ✓ | 23 | Very High | ✓ | 45 | High – Very High | - |
| 2 | Very High | ✓ | 24 | Very High | ✓ | 46 | Moderate – High | - |
| 3 | High | ✓ | 25 | High – Very High | ✓ | 47 | High – Very High | ✓ |
| 4 | High – Very High | ✓ | 26 | High – Very High | ✓ | 48 | Very High | ✓ |
| 5 | High – Very High | ✓ | 27 | Very High | ✓ | 49 | Very High | ✓ |
| 6 | High – Very High | ✓ | 28 | High – Very High | ✓ | 50 | High – Very High | ✓ |
| 7 | Moderate – High | - | 29 | High – Very High | ✓ | 51 | Very High | ✓ |
| 8 | High – Very High | ✓ | 30 | High | - | 52 | High – Very | ✓ |
| 9 | High – Very High | ✓ | 31 | High – Very High | ✓ | 53 | High – Very High | ✓ |
| 10 | High – Very High | ✓ | 32 | High – Very High | ✓ | 54 | High | ✓ |
| 11 | High – Very High | - | 33 | Very High | ✓ | 55 | High – Very High | ✓ |
| 12 | High – Very High | ✓ | 34 | High – Very High | ✓ | 56 | High – Very High | - |
| 13 | Very High | ✓ | 35 | Very High | ✓ | 57 | High – Very High | - |
| 14 | Very High | ✓ | 36 | High – Very High | ✓ | 58 | High – Very High | - |
| 15 | High – Very High | ✓ | 37 | High – Very High | ✓ | 59 | High – Very High Important | ✓ |
| 16 | High – Very High | ✓ | 38 | High | ✓ | 60 | High – Very High - | - |
| 17 | High | - | 39 | High | ✓ | 61 | Moderate – High - | - |
| 18 | High | ✓ | 40 | High – Very High | ✓ | 62 | High – Very High | ✓ |
| 19 | High – Very High | ✓ | 41 | Moderate – High | - | 63 | Very High | ✓ |
| 20 | High – Very High | ✓ | 42 | High | ✓ | 64 | Moderate – High | ✓ |
| 21 | Very High | ✓ | 43 | High – Very High | ✓ | 65 | Moderate | - |
| 22 | High – Very High | - | 44 | Moderate – High | - | | | |

Exemplar results

| Hedgerow Number | Apple, crab | Ash | Alder Buckthorn | Blackthorn | Cherry, wild | Dogwood | Elder | Elm | Guelder-rose | Hawthorn | Hazel | Holly | Maple, field | Oak | Privet, Wild | Rose | Sycamore | Wayfaring-tree | Willow | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | ✓ | ✓ | | ✓ | | |
| 2 | ✓ | ✓ | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | | | | ✓ |
| 3 | ✓ | | | ✓ | | | ✓ | ✓ | | ✓ | ✓ | | ✓ | | ✓ | ✓ | | ✓ | | |
| 4 | ✓ | | | ✓ | | | ✓ | | | ✓ | | | ✓ | | ✓ | ✓ | | | | |
| 5 | ✓ | | | ✓ | | | ✓ | ✓ | ✓ | ✓ | | | ✓ | | | | | | | |
| 6 | ✓ | | | ✓ | | | ✓ | ✓ | | ✓ | | | | | ✓ | ✓ | | | | ✓ |
| 7 | ✓ | | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | | | | | | |
| 8 | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | | ✓ | | |
| 9 | | | | | | | ✓ | ✓ | | ✓ | | | | | ✓ | | | | | |
| 10 | ✓ | | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | | ✓ | | ✓ |
| 11 | ✓ | | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | | ✓ | | ✓ | | |
| 12 | | | | ✓ | | | ✓ | | | ✓ | | | | | | ✓ | | | | ✓ |
| 13 | | | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | | ✓ | | | | |
| 14 | | ✓ | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | | ✓ | | | | |
| 15 | | | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | | ✓ | | | | |
| 16 | ✓ | | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | | ✓ | | ✓ | ✓ | |
| 17 | | ✓ | | ✓ | | | ✓ | | | ✓ | | | | | | | | | | |
| 18 | | ✓ | | ✓ | | | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | | ✓ | | ✓ |
| 19 | ✓ | | | ✓ | | | ✓ | ✓ | | ✓ | | | | | | ✓ | | | | |

| Associated features | Hedgerow number |
|---|---|
| Historic Parish boundary | 1, 8 |
| Mediaeval Field Boundary | 11 |

| Hedgerow Number | HEGS Value | Important hedgerows |
|---|---|---|
| 1 | Very High | ✓ |
| 2 | High – Very High | ✓ |
| 3 | Very High | ✓ |
| 4 | High – Very High | ✓ |
| 5 | Moderate – High | ✓ |
| 6 | High – Very High | ✓ |
| 7 | High | - |
| 8 | Very High | ✓ |
| 9 | Moderate – High | - |
| 10 | Very High | ✓ |
| 11 | Very High | ✓ |
| 12 | Moderate – High | - |
| 13 | High | - |
| 14 | High – Very High | ✓ |
| 15 | High – Very High | ✓ |
| 16 | Very High | ✓ |
| 17 | High – Very High | - |
| 18 | Very High | ✓ |
| 19 | High – Very High | - |

Woody species recorded in hedgerows during Hyder surveys in 2010.

**Hedgerows Regulations (1997) Record Sheet**

**(see accompanying notes for an explanation of the terms and definitions used)**

Complete the table by using a '✓' for each feature present along each hedgerow.

| Hedge No. | H1a | H1b | H2 | H3a | H3b | H4 | H5 | H6 | H7a | H7b |
|---|---|---|---|---|---|---|---|---|---|---|
| **Important** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | x | x |
| **Bridleway/path** | x | x | x | x | x | x | x | x | x | x |
| **Pn/Sot/Tic/Tip** | x | x | x | x | x | x | x | x | x | x |
| **No. woody spp./30m** | 6 | 7 | 6 | 6 | 7 | 7 | 7 | 6 | 5 | 5 |
| **Bank/wall** | x | x | x | x | x | x | x | x | x | x |
| **Intact** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Trees** | ✓ | ✓ | ✓ | X | ✓ | x | ✓ | x | x | x |
| **3 flora spp.** | x | x | x | x | x | x | x | x | x | x |
| **Ditch** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | x | ✓ | ✓ | ✓ |
| **Connect ≥ 4 points** | x | x | 4 ✓ | 4 ✓ | 4 ✓ | x | x | 4 ✓ | 4 ✓ | 4✓ |
| **Parallel hedge** | x | x | x | x | x | x | x | x | x | x |
| **Woody ssp present** | Um Fe Cm Ros Ps Liv | Um Fe Cm Ros Ps Liv Sn | Fe Cm Ps Ac Ms Rc | Fe Cm Ps Ac Ros Um | Fe Cm Ps Ac Um Ca Sn | Ps Cm Ros Fe Rc Sn Liv | Cm Sn Ca Ac Ros Ps Rc | Fe Um Ps Cm Ros Sn | Um Ros Cm Ps Fe | Fe Um Ros Cm Sn |
| | | | | | | | | | | |

**H1:** Hedge approx 100m in length dominated by Cm, Ps and Um with mature trees, predominantly Fe.

**H2:** Hedge forming eastern edge of block of plantation woodland.

| Hedge No. | H8 | H9a | H9b | H9c | H10 | H11 | H12 | H13 | H14 | H15 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Important** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | x | x | ✓ |
| **Bridleway/path** | x | x | x | x | x | x | x | x | x | x |
| **Pn/Sot/Tic/Tip** | x | x | x | x | x | x | x | x | x | x |
| **No. woody spp./30m** | 6 | 7 | 8 | 7 | 7 | 6 | 6 | 3 | 5 | 7 |
| **Bank/wall** | x | x | x | x | x | x | x | x | x | x |
| **Intact** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Trees** | ✓ | x | x | ✓ | x | ✓ | X | ✓ | x | ✓ |
| **3 flora spp.** | x | x | x | x | x | x | X | x | x | x |
| **Ditch** | ✓ | x | x | ✓ | ✓ | ✓ | ✓ | x | x | ✓ |
| **Connect ≥ 4 points** | 4 ✓ | 4 ✓ | 4 ✓ | 4 ✓ | 4 ✓ | 4 ✓ | 4 ✓ | x | x | 4 ✓ |
| **Parallel hedge** | x | x | x | x | x | x | x | x | x | x |
| **Woody ssp present** | Um Ros Fe Cm Ms Ps | Ms Ca Fe Ps Sn Ac Vl | Fe Ps Sn Ac Ms Um Ros Ca | Ps Cm Ac Fe Ms Rc Sn | Ac Um Cm Ros Fe Ps Rc | Um Ros Sn Cm Ac Liv | Fe Um Cm Rc Ros Ps | Ps Fe Ms | Ps Rc Cm Fe Um | Fe Um Ps Sn Ms Ros Cos |
| **Notes see below** | * | * | | | * | * | * | * | * | * |

**H8:** Hedge approx 100m in length dominated by Um,

**H9:** Hedge approx 250m in length dominated by Ac

**H10:** Hedge approx 75m dominated by Cm and Ps

**H11:** Hedge approx 75m dominated by Cm

**H12:** Hedge dominated by Um

**H13:** Hedge dominated by Ps

**H14**: Hedge dominated by Ps

**H15**: Hedge approx 60m dominated by Ps

| Hedge No. | H16 | H17a | H17b | H18a | H18b | H19 | H20a | H20b | H21a | H21b |
|---|---|---|---|---|---|---|---|---|---|---|
| **Important** | ✓ | ✓ | ✓ | ✓ | x | ✓ | x | x | ✓ | x |
| **Bridleway/path** | x | x | x | x | x | x | x | x | x | x |
| **Pn/Sot/Tic/Tip** | x | x | x | x | x | x | x | x | x | x |
| **No. woody spp./30m** | 7 | 7 | 7 | 7 | 6 | 7 | 6 | 5 | 8 | 5 |
| **Bank/wall** | x | x | x | x | x | x | x | x | x | x |
| **Intact** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | x | X | x | ✓ |
| **Trees** | x | x | x | x | X | X | ✓ | ✓ | x | ✓ |
| **3 flora spp.** | x | x | x | x | X | X | x | x | x | x |
| **Ditch** | ✓ | ✓ | ✓ | X | X | ✓ | x | x | x | x |
| **Connect ≥ 4 points** | 4 ✓ | 4 ✓ | 4 ✓ | 4 ✓ | 4 ✓ | x | 4 ✓ | 4 ✓ | 4 ✓ | 4 ✓ |
| **Parallel hedge** | x | x | x | x | x | x | x | x | x | x |
| **Woody ssp present** | Cm Sn Ac Um Fe Ps Ms Rc | Cm Um Ps Ros Liv Sn Ac | Fe Ros Ac Cm Sn Cos Um | Fe Cm Sn Ps Ros Ac Ms | Ac Fe Cm Ps Ros Um | Fe Um Cm Ps Rc Sn Ros | Cm Rc Ps Ms Sn Ros | Ps Cm Sn Fe Ros | Um Cm Sn Fs Ms Ps Fe Ros | Cm Sn Ros Ps Ee |
| **Notes see below** | * | * | | * | | * | * | | * | |

**H16:** Hedge approx 100m in length dominated by Ps

**H17:** Hedge approx 150m dominated by Um and Cm adjacent to dry ditch with Bramble and tall ruderal species adjacent

**H18:** Hedge approx 200m in length dominated by Ps with frequent Bramble

**H19:** Hedge approx 70m dominated by Cm

**H20**: Hedge approx 200m in length dominated by Ps and Cm with Um and Sycamore (*Acer pseudoplatanus*

**H21**: Hedge approx 200m in length dominated by Cm

| Hedge No. | H22 | H23 | H24 | H25a | H25b | H26a | H26b |
|---|---|---|---|---|---|---|---|
| **Important** | x | x | ✓ | ✓ | ✓ | x | x |
| **Bridleway/path** | x | x | x | x | x | x | x |
| **Pn/Sot/Tic/Tip** | x | x | x | x | x | x | x |
| **No. woody spp./30m** | 4 | 4 | 7 | 7 | 7 | 5 | 4 |
| **Bank/wall** | x | x | x | x | x | x | x |
| **Intact** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Trees** | ✓ | ✓ | x | ✓ | ✓ | x | x |
| **3 flora spp.** | x | x | x | x | x | x | x |
| **Ditch** | ✓ | x | ✓ | x | x | ✓ | ✓ |
| **Connect ≥ 4 points** | x | 4 ✓ | 4 ✓ | 4 ✓ | 4 ✓ | x | x |
| **Parallel hedge** | x | x | x | x | x | x | x |
| **Woody ssp present** | Cm Ps Um Ms | Fe Cm Ac Sn | Fe Ros Cm Um Ps Rc Ms | Fe Um Ms Ac Cm Ps Ros | Cm Ps Ac Ros Sn Fe Um | Um Ps Fe Cm Sn | Um Ps Cm Ms |
| **Notes see below** | * | | | * | | * | |

**H22:** Hedge approx 100m in length dominated by Cm, Ps and Um

**H25:** Hedge approx 200m in length with semi-mature trees including Fe and Ms

**H26:** Hedge approx 150m in length dominated by Ps

**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 | Latin name | English name | Spp code | Latin name | English code |
|---|---|---|---|---|---|
| **Ac** | *Acer campestre* | Field Maple | **Pa** | *Prunus avium* | Wild Cherry |
| **Ag** | *Alnus glutinosa* | Alder | **Pp** | *Prunus padus* | Bird Cherry |
| **Bpe** | *Betula pendula* | Silver Birch | **Ps** | *Prunus spinosa* | Blackthorn |
| **Bpu** | *Betula pubescens* | Downy Birch | **Pyc** | *Pyrus communis* | Pear |
| **Bxs** | *Buxus sempervirens* | Box | **Qp** | *Quercus petraea* | Sessile Oak |
| **Cb** | *Carpinus betulus* | Hornbeam | **Qr** | *Quercus robur* | Pedunculate Oak |
| **Cos** | *Cornus sanguinea* | Dogwood | **Rc** | *Rhamnus catharticus* | Buckthorn |
| **Ca** | *Corylus avellana* | Hazel | **Ruv** | *Ribes uva-crispa* | Gooseberry |
| **Cla** | *Crataegus laevigata* | Midland Hawthorn | **Ros** | *Rosa* sp(p) | Rose |
| **Cm** | *Crataegus monogyna* | Hawthorn | **Rac** | *Ruscus aculeatus* | Butcher's-broom |
| **Cys** | *Cytisus scoparius* | Broom | **Sx** | *Salix* sp(p) | Willow |
| **Dl** | *Daphne laureola* | Spurge-laurel | **Sxca** | *Salix caprea* | Goat Willow |
| **Ee** | *Euonymus europaeus* | Spindle | **Sxf** | *Salix fragilis* | Crack-willow |
| **Fs** | *Fagus sylvatica* | Beech | **Sxv** | *Salix viminalis* | Osier |
| **Fa** | *Frangula alnus* | Alder Buckthorn | **Sn** | *Sambucus nigra* | Elder |
| **Fe** | *Fraxinus excelsior* | Ash | **Sac** | *Sorbus aucuparia* | Rowan |
| **Hr** | *Hippophae rhamnoides* | Sea-buckthorn | **Sor** | *Sorbus* sp(p) | Whitebeam |
| **Ia** | *Ilex aquilfolium* | Holly | **Sot** | *Sorbus torminalis* | Wild Service-tree |
| **Jr** | *Juglans regia* | Walnut | **Tb** | *Taxus baccata* | Yew |
| **Jc** | *Juniperus communis* | Common Juniper | **Tic** | *Tilia cordata* | Small-leaved Lime |
| **Liv** | *Ligustrum vulgare* | Wild Privet | **Tip** | *Tilia platyphyllos* | Large-leaved Lime |

| | | | | | |
|---|---|---|---|---|---|
| **Ms** | *Malus sylvestris* | Crab Apple | **Ue** | *Ulex europaeus* | Gorse |
| **Pal** | *Populus alba* | White Poplar | **Ug** | *Ulex gallii* | Western Gorse |
| **Pn** | *Populus nigra sub-species betulifolia* | Black-poplar | **Umi** | *Ulex minor* | Dwarf Gorse |
| **Pot** | *Populus tremula* | Aspen | **Um** | *Ulmus* sp(p) | Elm |
| **Pcan** | *Populus x canescens* | Grey Poplar | **Vl** | *Viburnum lantana* | Wayfaring-tree |
| | | | **Vop** | *Viburnum opulus* | Guelder-Rose |

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 50 m length of hedgerow (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', where 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 10 m 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 — Would the hedgerow be 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)).

# Appendix 6E Aquatic Invertebrates recorded in 2012

## Sample Location 1: Downstream of Exemplar Site (Grid reference SP 57769 24730)) location shown on Drawing 6-2

| Taxa | Family | Species | Number | Relative Abundance |
|---|---|---|---|---|
| | | | | |
| Gastropod | Planorbidae | *Anisus vortex* | 20 | 0.061728395 |
| | | *Bathyomphalus contortus* | 5 | 0.015432099 |
| | Lymnaeidae | *Lymnaea palustris* | 16 | 0.049382716 |
| | | *Lymnaea peregra* | 169 | 0.521604938 |
| | | | | |
| Bivalve | Sphaeroidea | *Sphaerium corneum* | 1 | 0.00308642 |
| | | | | |
| Malacostraca | Aesllidae | *Asellus aquaticus* | 24 | 0.074074074 |
| | Gammaridae | *Gammarus pulex* | 30 | 0.092592593 |
| | | | | |
| Ephemeroptera | Baetidae | Baetis rhodani | 26 | 0.080246914 |
| | | | | |
| Coleoptera | Gyrinidae | *Gyrinus substriatus* | 1 | 0.00308642 |
| | Haliplidae | *Haliplus lineatocollis* | 2 | 0.00617284 |
| | Hydrophilidae | *Laccobius bipunctatus* | 1 | 0.00308642 |
| | Dytiscidae | *Agabus didymus* | 1 | 0.00308642 |
| | | *Dyticidae spp Larve* | 2 | 0.00617284 |
| | | | | |
| Tricoptera | Limnephilidae | *Micropterna sequax* | 14 | 0.043209877 |
| | | | | |
| Oligocheata | Oligochaeta | *Oligocheat worm* | 5 | 0.015432099 |
| | | | | |
| Diptera | *Tipulidae* | *Tipulidae spp* | 4 | 0.012345679 |
| | *Simulidae* | *Simulidae spp* | 1 | 0.00308642 |
| | *Chironomidae* | *Chironomidae spp.* | 2 | 0.00617284 |
| | | | | |
| No. identified Taxa | | | 18 | |
| Total number of invertebrates | | | 324 | |

## Sample Location 2: Exemplar Site (Grid reference SP 57870 24884) location shown on Drawing 6-2

| Taxa | Family | Species | Numbers | Relative Abundance |
|---|---|---|---|---|
| Gastropod | Hydrobiidae | *Potamopyrgus antipodarum* | 1 | 0.001302 |
| | Planorbidae | *Anisus vortex* | 70 | 0.091146 |
| | | *Bathyomphalus contortus* | 25 | 0.032552 |
| | Lymnaeidae | *Lymnaea palustris* | 66 | 0.085938 |
| | | *Lymnaea peregra* | 415 | 0.540365 |
| Bivalve | Sphaeroidea | *Sphaerium corneum* | 11 | 0.014323 |
| | | *Pisidium casertanum* | 5 | 0.00651 |
| | | *Pisidium milum* | 5 | 0.00651 |
| Malacostraca | Aesllidae | *Asellus aquaticus* | 127 | 0.165365 |
| | Gammaridae | *Gammarus pulex* | 17 | 0.022135 |
| Ephemeroptera | Baetidae | Baetis rhodani | 1 | 0.001302 |
| Coleoptera | Dytiscidae | *Agabus bipustulatus* | 3 | 0.003906 |
| | | *Dyticidae spp Larve* | 3 | 0.003906 |
| Tricoptera | Limnephilidae | *Micropterna sequax* | 1 | 0.001302 |
| | | *Limnephilus lunatus* | 1 | 0.001302 |
| | | *Limniphilidae spp case only* | 6 | 0.007813 |
| Oligocheata | Oligochaeta | *Oligocheat worm* | 5 | 0.00651 |
| Diptera | *Tipulidae* | *Tipulidae spp* | 2 | 0.002604 |
| | *Chironomidae* | *Chironomidae spp.* | 4 | 0.005208 |
| No. identified Taxa | | | 19 | |
| Total number of invertebrates | | | 768 | |

## Sample Location 3: Upstream of Exemplar Site (Grid reference SP 57970 24997) location shown on Drawing 6-2

| Taxa | Family | Species | Numbers | Relative abundance |
|---|---|---|---|---|
| Gastropod | Planorbidae | *Anisus vortex* | 62 | 0.063917526 |
| | | *Bathyomphalus contortus* | 12 | 0.012371134 |
| | | *Planorbis carinatus* | 2 | 0.002061856 |
| | Lymnaeidae | *Lymnaea palustris* | 25 | 0.025773196 |
| | | *Lymnaea peregra* | 215 | 0.221649485 |
| Bivalve | Sphaeroidea | *Sphaerium corneum* | 41 | 0.042268041 |
| | | *Pisidium casertanum* | 57 | 0.058762887 |
| Malacostraca | Aesllidae | *Asellus aquaticus* | 408 | 0.420618557 |
| | Gammaridae | *Gammarus pulex* | 66 | 0.068041237 |
| Ephemeroptera | Baetidae | *Baetis rhodani* | 13 | 0.013402062 |
| Odonata | Aeshnidae | *Aeshna cyanea* | 1 | 0.001030928 |
| Coleoptera | Gyrinidae | *Gyrinus substriatus* | 1 | 0.001030928 |
| | Dytiscidae | *Agabus sturmii* | 2 | 0.002061856 |
| | | *Agabus didymus* | 5 | 0.005154639 |
| | | *Dyticidae spp Larve* | 1 | 0.001030928 |
| Tricoptera | Limnephilidae | *Micropterna sequax* | 20 | 0.020618557 |
| | | *Limnephilus lunatus* | 1 | 0.001030928 |
| | | *Limniphilidae spp case only* | 26 | 0.026804124 |
| Oligocheata | Oligochaeta | *Oligocheat worm* | 8 | 0.008247423 |
| Diptera | *Tipulidae* | *Tipulidae spp* | 1 | 0.001030928 |
| | *Chironomidae* | *Chironomidae spp.* | 3 | 0.003092784 |
| No. identified Taxa | | | 21 | |
| Total number of invertebrates | | | 970 | |

# Appendix 6F Terrestrial and Aquatic Invertebrates recorded in 2010

(Report produced by Colin Plant Associates)

Commissioned by
**ARUP**
13 Fitzroy St
London
W1T 4BQ

# BICESTER ECO-TOWN
## MASTERPLAN & EXEMPLAR SITE
## INVERTEBRATE SURVEY REPORT

Report number BS/2541/10

October 2010

Prepared by

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# 1 INTRODUCTION AND METHODOLOGY

1.1 **Colin Plant Associates (UK)** were commissioned during June 2010 by **Arup** to undertake an investigation of invertebrates on an area of land to the north-west of Bicester in Oxfordshire upon which it is proposed to develop new housing.

1.2 An initial site visit was made on 29th June 2010, when a walk-over survey of the entire site was undertaken in order to determine the nature and extent of detailed survey work required. Subsequent visits were undertaken on

| Date | Session | Activity |
|---|---|---|
| | | |
| 3 – 4 July | overnight | moth recording |
| 4 July | day | terrestrial sampling; |
| 16 – 17 July | overnight | moth recording |
| 17 July | day | terrestrial sampling; |
| 1 – 2 August | overnight | moth recording |
| 2 August | day | terrestrial sampling; |
| 22 – 23 August | overnight | moth recording |
| 23 August | day | terrestrial sampling; |
| 26 – 27 September | overnight | moth recording |
| 27 September | day | terrestrial sampling; |
| 7 – 8 October | overnight | moth recording |
| 8 October | day | terrestrial sampling; aquatic sampling |
| 21 October | day | terrestrial sampling; aquatic sampling |

1.3 On all visits, terrestrial invertebrates were recorded by direct observations of both species and their signs (such as leaf mines and plant galls). In addition active sampling was also undertaken as follows:

**Sweep-netting.** A stout hand-held net is moved vigorously through vegetation to dislodge resting insects. The technique may be used semi-quantitatively by timing the number of sweeps through vegetation of a similar type and counting selected groups of species. This technique is effective for many invertebrates, including several beetle families, most plant bug groups and large number of other insects that live in vegetation of this type.

**Beating trees and bushes.** A cloth tray, held on a folding frame, is positioned below branches of trees or bushes and these are sharply tapped with a stick to dislodge insects. The same technique can be applied to tall perennial herbs and other plants that tower over a sward. Black or white trays are used depending upon which group of invertebrates has been targetted for search. Insects are collected from the tray using a pooter. This technique is effective in obtaining records of most arboreal species, including many beetle groups, bugs, caterpillars of Lepidoptera, spiders and others. It can be undertaken at any site where there are trees or bushes present although is rendered ineffective if the vegetation is wet or if the weather is windy.

**Suction Sampling** consists of using a converted leaf blower to collect samples from grass and other longer ground vegetation. The sample is then everted into a net bag and the invertebrates removed with a pooter. The advantage of suction sampling is that it catches species which do not fly readily or which live in deep vegetation. It is particularly productive for Coleoptera, some Diptera and Arachnida.

1.4 We also undertook passive sampling. This is effective because it does not depend upon the physical presence of the surveyor and it records species throughout the entire trap period.

**Pitfall trapping.** Vending-machine cups or similar are placed in the ground with the rim flush with, or slightly below, the surface. A fluid is added, containing ethylene glycol, sodium chloride and formalin with a little detergent to reduce surface tension. Holes made in the sides of the cups a couple of centimetres below the rim permit flood or rain water to drain without the traps over-flowing and the catch becoming lost. Invertebrates simply fall into the traps.

Pitfall traps were established in compartment T1 (Gowell Farm area). This area was selected as being representative, in part because it was the least likely zone to be disturbed by harvest, ploughing or other activities that would destroy the traps.

1.5 A**ctinic light trapping**. Normally, nocturnal recording of moths would involve operating 125-watt mercury vapour lamps from a portable generator. However, in order to trap a large number of separate sites on the same night, such a technique would have been difficult because of both the need to refuel generators and the potential security issues relating to the use of the very obvious lights. We therefore used small size actinic traps, operated from 12 volt burglar-alarm batteries, and left these running from early evening to the following morning. These units are discrete because, whilst still having an output in the safe zone of the UV range, their light output in the visible part of the spectrum is reduced; thus, they can be tucked away in undergrowth at the side of a track without passers-by noticing them. For the same reasons of light emission, they attract moths and other insects from a much shorter distance and so the resultant catch is usually more representative of the habitat selected, in comparison with that in mercury vapour traps which attract flying species from a much wider area of the countryside.

1.6 A formal search was undertaken for existing data was not specifically requested. After we had made an initial visual inspection of the habitats present on site we determined that this was likely to be unproductive. Nevertheless, during the course of the project we approached a number of key colleagues informally; as a result of this we are satisfied that no important invertebrate data has been overlooked.

## 2 OVERVIEW OF INVERTEBRATE HABITATS ON THE SITE

### 2.1 Preamble

2.1.1 The site is extensive, extending approximately three kilometres across at its widest points, although it is of an irregular shape. It occupies an area of level and slightly undulating lowland in the central part of England where it is separated from any maritime influence.

2.1.2 The lowest point of the site is marked by the 80 metre contour immediately north-east of Lord's Farm in the south, whilst the 100 metre contour runs through the churchyard at Bucknell village in the highest point to the north.

2.1.3 The soil appears to be based upon a clay component and does not seem to drain particularly rapidly after rainfall. The soil is evidently nutrient-rich and much of the site is given over to arable crop production.

2.1.4 Wildlife habitats here will be governed by these over-riding ecological parameters. They are now examined, specifically as they affect invertebrate ecology.

### 2.2 Terrestrial invertebrate habitats

2.2.1 Terrestrial habitats within the surveyed area are dominated by the overwhelmingly arable landscape. Most fields are ploughed annually and sown with a crop; those few which are not so treated are mostly pasture for cattle or sheep and so are often closely-grazed.

2.2.2 Hedges, rather than fences, define the field boundaries in most places. However, most of these hedges are likely to be of low value as invertebrate habitats – at least on a permanent basis. This is because almost all hedges are either trimmed or flailed, thus removing both invertebrates and their sources of food.

2.2.3 Recent research by personnel at Oxford University has shown that hedges, even poorly-structured monocultural ones, support a greater numerical abundance (though not necessarily a greater species diversity) of insects if there are standard trees retained within their lengths. A few of the hedges on the site do contain standard trees, mostly ash or oak and some of these appear to be mature and contain amounts of aerial dead timber (an important micro-habitat for invertebrates).

2.2.4 Marginal areas of fields are, in general, narrow or absent and when they are present they appear to be dominated by rank grasses. In general, most field margins appear to provide rather poor quality invertebrate habitats.

2.2.5 For similar reasons, transitional edge habitats, where there is a gradual physical change in height from low grassland to tall woodland, are very poorly represented and in most areas appear absent.

2.2.6 Woodland is represented by a number of small units. Most of these appear on the 1945 aerial photographs and so may be of some age, though the bulk of trees are young in comparison. Ash is the dominant tree in the landscape and is the main feature of these woodland units, usually joined by oaks and occasionally other trees.

2.2.7 These woodland units are widely spaced within the arable landscape and are joined only by relatively poor-quality hedges or else are quite isolated. Continuous woodland does not feature on the site and so true woodland invertebrates are probably absent.

2.2.8 Consequent upon this, and perhaps also upon the use of the small woodland units for pheasant rearing, the dead wood resource is minimal and other saproxylic habitats are also very poorly represented.

2.2.9 Other micro-habitat features are generally scarce. In the derelict yard of Gowell Farm, the remnants of a long-disused muck pile generated a healthy list of common rove beetles showing there to be a reservoir of such species in the area, but suitable habitat elsewhere on the site could not be found.

## 2.3 Aquatic invertebrate habitats

2.3.1 Both running water and static ponds are represented on the site and are now briefly discussed.

2.3.2 Most of the streams on the site were dry in the summer months and are generally regarded as being winterbournes. As such, their invertebrate complement will be minimal (although permanent winterbournes may develop a small but specialist fauna of water beetles in particular).

2.3.3 In summer months, searching for aquatic invertebrates in the dried or near dry courses will, quite obviously, be unproductive. Searching in the winter, though before the frosts, would probably reveal the greatest number of species.

2.3.4 During 2010, the return of water to the bulk of water courses started in September. Examinations undertaken in early October up to and including the final visit on 21st October 2010, showed that some of the watercourses remained dry, others were damp but lacked flowing water. Only the main stream, that flowing from near Crowmarsh Farm to pass under the railway embankment in the vicinity of Aldershot Farm before passing woodland south of Hawkwell Farm and so beyond the site boundary beneath Lord's Lane, contained a flow of water.

2.3.5 Two ponds were indicated to us in maps of the site. One is in the vicinity of Crowmarsh Farm (compartment A2 in the list below); the other is in the vicinity of Lower Farm, to the north (compartment A6).

## 3 SELECTION OF HABITAT AREAS FOR DETAILED EXAMINATION

3.1 It has been indicated above that largest part of the site is evidently unsuitable for invertebrates; this requires no sampling. However, the several small and localised habitat units across the site are of potential invertebrate interest and sampling of these was undertaken.

3.2 These terrestrial sample areas are defined in Map 1 where they are given recording compartment numbers that repeat in the species inventory at Appendices 1 and 2. These areas are now introduced in greater detail.

**Terrestrial habitat compartment T1: Gowell Farm area**

Gowell Farm is abandoned and the buildings are derelict. The concrete farmyard has been invaded by ruderal vegetation and scrub to provide a mosaic of young habitat that is poorly-represented elsewhere in the surveyed area.

Tree species here seem rather more varied than in the ash-dominated woodland units and include Elder, hawthorn, Sycamore, Turkey Oak, Damson, Sweet Chestnut, Birch and others.

Hedges here are overgrown and provide a stark, but ecologically welcome, contrast with the manicured hedges elsewhere on the site. The twigs of the hedgerow plants have become colonised with various lichens. A long-abandoned muck pile is still evident in a few places.

A mature oak tree, containing a reasonable quantity of aerial dead timber, guards the entrance to the farmyard on the southern side of the access track.

Actinic moth traps were operated by us in this compartment on selected dates.

**Terrestrial habitat compartment T2**

This appears to be a section of the former road. It is now isolated on the north side of the existing road and the marginal trees and bushes have become overgrown to provide something approaching a structured edge habitat – a feature that is very poorly represented on the site overall.

Trees here include Elm, Ash, Field Maple, birches, hawthorns, willows and poplars and are adorned with Ivy and occasional Hop plants. Non-natives such as cherry and Snowberry are also evident in a few places, but do not detract from the likely raised ecological value of this compartment.

Brambles dominate the under-storey in most places but there are also tall perennial herbs such as Great Willow-herb and other species that will inevitably add to the invertebrate biodiversity of this small area.

Actinic moth traps were operated by us in this compartment on selected dates.

**Terrestrial habitat compartment T3**

This is a small woodland unit typical of the many others on the site. It is dominated by Ash but other trees are also present. In general, the lower layers of flora beneath the canopy are restricted but at the edges in particular there is greater diversity of plant life and so potentially raised invertebrate interest.

**Terrestrial habitat compartment T4**

This is a zone of unmown vegetation with between a hedge and an arable field. As an invertebrate habitat it is likely to be poor, but it is a habitat type that is rare on the site and so was sampled.

**Terrestrial habitat compartment T5**

This is another Ash-dominated woodland, not dissimilar to compartment T3. Other ttrees here included elm and Elder and as always there is a dominance of brambles on the ground beneath the trees. However, unlike in T3, we were able to operate actinic moth traps in this unit on some visits.

**Terrestrial habitat compartment T6: Grunthill Copse**

This small woodland unit has a better mix of trees incorporated with the Ash that forms its basis. Deciduous oaks, elm, hawthorn, Field Maple and Beech all feature. These are joined by bramble and wild rose and there were also patches covered by White Bryony.

Actinic moth traps were operated by us in this compartment on selected dates.

**Terrestrial habitat compartment T7**

This is the small, Ash-dominated woodland behind the pond at Crowmarsh Farm. It is relatively small and uninteresting from an invertebrate viewpoint but it provides screening and micro-climate control for the adjacent pond.

Actinic moth traps were operated by us in this compartment on selected dates.

**Terrestrial habitat compartment T8**

This compartment does not feature in Map 1. It is a catch-all category for records of invertebrates made casually along hedgerows within the surveyed area.

3.3 The aquatic sample areas are also indicated in Map 1 where they are given recording compartment numbers that repeat in the species inventory at Appendices 2 and 3. These areas are now introduced in greater detail.

**Aquatic habitat compartment A1**

This section of the stream, near its source at a spring, flows across arable fields in a shallow channel that is bordered on each side by a strip of rank grassland vegetation extending about one metre. Te channel is largely dominated by grasses and other invading terrestrial vegetation and no aquatic macrophytes were evident during sampling sessions.

**Aquatic habitat compartment A2**

This is the pond that separates Compartments A1 and A3. It was created artificially by mechanical excavation of the stream and is up to 4 metres deep in places (unconfirmed third party information). There is a zone of marginal vegetation that may be of value to invertebrates.

**Aquatic habitat compartment A3**

This is a section of the main stream as it runs under the cover of a hedge. It is largely shaded and there are no aquatic macrophytes evident.

**Aquatic habitat compartment A4**

This section of the main stream flows beneath the cover of another overgrown hedge and is equally shaded and devoid of aquatic plants.

**Aquatic habitat compartment A5**

This downstream section of the watercourse is also heavily shaded but as it emerges into young woodland light penetrates from the side. In this area it flows fairly rapidly over a gravel substrate but is sufficiently shallow that young pheasants released into the wood in the autumn simply walk across it when the surveyor approaches!

**Aquatic habitat compartment A6**

This ornamental pond does not feature on 1945 aerial photographs and so is evidently a more recent artificial construction.

# 4 RESULTS OF TERRESTRIAL INVERTEBRATE SAMPLING

## 4.1 Summary

4.1.1 Appendix 1 reports the complete list of insect taxa encountered during the survey. The list is annotated with formal National Status codes where these are better than "nationally common" and these status codes are explained in Appendix 2.

4.1.2 A total of 560 invertebrate species was recorded. This is an acceptable total for the effort input and indicates that the level of sampling achieved is adequate to permit an assessment of the site. The more noteworthy amongst these are now briefly discussed.

## 4.2 Species of conservation interest

4.2.1 Several categories of invertebrates are of raised significance in an ecological assessment. These categories are explained in Appendix 2 and the corresponding species are now examined.

Legally Protected Species

4.2.2 No invertebrate species that are afforded direct legal protection under any UK or European legislation were encountered during the survey.

UK Biodiversity Action Plan Priority Species

4.2.3 One UK BAP species was recorded during the survey.

**The Small Heath Butterfly *Coenonympha pamphilus*** is a grassland species that has declined in recent years. It was added to the UK BAP list at the end of 2007 though there are disagreements over the need for this action. It remains widespread, though it has declined numerically so that whereas twenty years ago it was usual to see dozens if an afternoon it is now more likely that less than twenty or so will be seen.

At Bicester, we saw only very few examples in the area around Gowell Farm (Compartment T1).

4.2.4 The list of UK Biodiversity Action Plan Priority Species *of moths* is divided into two sections. In the first, a total of 81 species are afforded the status of UK BAP Priority Species; none of these is recorded in the surveyed area nor is any likely to be present.

4.2.5 The second section is a list of 69 species that have declined in population by a significant amount in the past 25 years. These are not yet rare and are flagged as UK BAP species "**for research only**". They were inadvertently included in the overall BAP list by non-specialists.

4.2.6 This has resulted a confusing situation; these species were not intended to be affected by the requirements of *Planning Policy Statement 9: Biodiversity and Geological Conservation*, published by the Office of the Deputy Prime Minister during 2005, which requires Local Authorities to take measures to protect the habitats of UK BAP species from further decline through policies in local development documents. They were merely flagged for special attention.

4.2.7 At Bicester, we have recorded 9 such "Research Only" moth species; several others are confidently predicted to be present.

| Species | English name | Caterpillar feeds on | In terrestrial habitat area | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| *Agrochola lychnidis* | Beaded Chestnut | deciduous trees and shrubs and herbaceous plants (requires both) | + | + | | | | | | |
| *Allophyes oxyacanthae* | Green Brindled Crescent | rosaceous trees and shrubs | | + | | | | | | |
| *Atethmia centrago* | Centre-barred Sallow | ash - buds then flowers | + | + | | | + | + | + | |
| *Ecliptopera silaceata* | Small Phoenix | willow herbs, enchanter's nightshade | | + | | | | | | |
| *Hepialus humuli* | Ghost Moth | roots of grasses and herbaceous plants | + | | | | | | | |
| *Hydraecia micacea* | Rosy Rustic | herbaceous plants, especially docks, feeding in the rootstock | + | | | | | | | |
| *Melanchra persicariae* | Dot Moth | herbaceous plants | + | | | | | | | |
| *Tyria jacobaeae* | Cinnabar Moth | Ragwort | + | | | | | | | |
| *Xanthia icteritia* | Sallow | sallow/willow catkins - then on herbaceous plants | | + | | | | | | |

Red Data Book Species

4.2.8 One species listed in the British Red Data Books (Shirt, 1987; Bratton, 1991) or which has been elevated to the status of Critically Endangered, Endangered, Nationally Vulnerable or Near Threatened (formerly Nationally Rare) by subsequent formal reviews is recorded in the present survey.

***Stigmella samiatella*** is a minute micro-moth whose caterpillars feed internally in the leaves of Sweet Chestnut trees, leaving a whitish galley – or "mine". It was provisionally placed in Red Data Book category 3, but has since proved to be widespread and common in the south of England wherever Sweet Chestnut grows. This may reflect a genuine range expansion, rather than it having been overlooked, but either way the status is not at all warranted.

Mines were found on a tree at Gowell Farm (compartment T1).

Nationally Scarce Species

4.2.9 No species recorded feature in the Nationally Scarce (formerly Nationally Notable - Na) category (see Appendix 2).

4.2.10 Five species recorded feature in the Nationally Scarce (formerly Nationally Notable - Nb) category (see Appendix 2).

**The Shaded Pug moth (*Eupithecia subumbrata*)** feeds as a caterpillar on a wide range of herbaceous plants. It is widespread across south-eastern England, though less frequent elsewhere, but it is only locally distributed and some apparently suitable sites do not seem to support it. On the basis that it might be declining, the Nationally Scarce status may be warranted.

Two adults were caught in an actinic trap at compartment T4.

**The bark beetle *Kissophagus hederae*** feds as a grub in the dead wood of mature ivy, and is usually only found in larger branches of the plant. This implies that established ivy, of some age is required so that this is in some way an indicator of habitat stability. Like many other species it is probably overlooked, but it appears to be genuinely absent from a great many sites examined.

We recorded adults in compartment T2.

**Roesel's Bush-cricket *Metrioptera roeselii*** has, recent years, undergone a very large expansion of range that is almost certainly climate-driven. In most years the insects develop without the ability to fly, but in favourable (hot) summers the females develop winged forms that are able to disperse after mating and establish populations in new areas. In the south-east of England, this cricket is present in considerable abundance in grassland habitats, including set-a-side, field margins, road verges and lightly grazed pastures where there is plenty of vegetation cover. The Nationally Notable status is no longer warranted and an unpublished document on the Internet has indeed reduced its status to Nationally Local.

We recorded adults at compartments T2 and T4 and also one in the rank grass that flanks aquatic compartment A1.

***Phyllonorycter platanoidella*** is a leaf-mining micro moth that is very much under-recorded. In the south of Britain, it is widespread and expected wherever Norway Maple is established and its status is not warranted. There is debate over whether this is a separate species from some other *Acer*-feeding *Phyllonorycter* species.

We found abundant mines of this moth on fallen leaves at Gowell Farm (compartment T1).

**The blue and red leaf beetle *Podagrica fuscicornis*** feeds as a grub in the flowers and seeds of mallow (*Malva* species). The plant has become a common feature of verges, hedgerows and other sites and the distinctive beetle has become quite frequent in the past few years.

We found examples at Gowell Farm (compartment T1); the host plant does not appear to be widespread across the survey area. .

Nationally Local Species

4.2.11 Twenty-one species are listed formally as Nationally Local (see Appendix 2). These are:

| Species | English name | Habitat associations | In terrestrial compartment | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | | | | | | | | | |
| *Amara lunicollis* | a ground beetle | grasslands, open woodland, gardens etc | + | | | | | | | |
| *Andrena flavipes* | a solitary bee | nests colonially, usually tunnelling into a vertical face | | | | | | | | + |
| *Anomoia purmunda* | a picture-winged fly | Larva feeds in the flesh of hawthorn berries | + | + | | | | + | | + |
| *Aphodius granarius* | a beetle | dung, rotting vegetation (compost heaps) and carcasses | + | | | | | | | |
| *Aphthona euphorbiae* | a leaf beetle | widely polyphagous | + | + | + | + | + | + | + | + |
| *Ceratapion carduorum* | a seed weevil | Thistles | + | | | | | | | |
| *Cordylepherus (Malachius) viridis* | a beetle | a common grassland species | + | | | + | | | | + |
| *Crepidodera plutus* | a leaf beetle | Willows, especially Crack Willow - rarely on poplars | | + | | | | | | |
| *Curculio glandium* | a weevil | Oak trees | + | | | | | | | + |
| *Curculio pyrrhoceras* | a weevil | oak - causing leaf galls | | | | | | | | + |
| *Dorytomus tortrix* | a weevil | in catkins of aspen and sallow | | + | | | | | | |
| *Hylaeus annularis* | a yellow-faced bee | nests in hollow plant stems, such as docks, etc | + | | | | | | | |
| *Lasioglossum leucopus* | a solitary bee | excavates nest burrow in level ground – preferring ruderal sites | + | | | + | | | | + |
| *Ledra aurita* | Hippopotamus froghopper | Oak trees | | | | | + | | | |
| *Nicrophorus vespilloides* | a beetle | carrion | + | | | | | | | |
| *Oplodontha viridula* | a soldier fly | marshes and pond margins | | | | | | + | | |
| *Phyllobius maculicornis* | a weevil | polyphagous on leaves of deciduous trees and shrubs | | + | | | | + | | + |
| *Psylliodes chrysocephala* | a weevil | various Cruciferae | | + | | | | | | |
| *Pterostichus (Poecilus) cupreus* | a ground beetle | open grassy habitats - usually where damp | + | | | | | | + | |
| *Rhamphus oxyacanthae* | a beetle | larva mines in leaves of hawthorn | | + | | | | | | |
| *Sicus ferrugineus* | a parasitic fly | parasitic fly on bumble bees | | | + | + | + | | | + |

### 4.3 Other species of interest

4.3.1 A third party report from a source regarded as reliable indicates the presence of the **White-letter Hairstreak butterfly (*Satyrium w-album*)** in association with a hedge containing elm re-growth in the extreme south-east corner of the site opposite Bignell Park. This butterfly declined drastically across Britain in the aftermath of the Dutch Elm Disease outbreak in the late 1970s and became extremely rare for several years. More recently it has apparently adapted to feeding (as a caterpillar) on elm suckers rather than requiring mature, flowering trees and has made a reasonable recovery. At 2010 it is widespread but rather local across southern and central England and is extending northwards, though it is absent from many apparently suitable sites and is nowhere numerically common.

# 5 RESULTS OF AQUATIC INVERTEBRATE SAMPLING

5.1 The species obtained by sampling representative aquatic habitats are presented in Appendix 3.

5.2 A rather low number of generally widespread and common species is recorded. This reflects the low quality of aquatic habitat on the site and is discussed below.

## 6 DISCUSSION

6.1 The initial impression of the whole site is that it is unlikely to be an invertebrate "hot-spot". Arable fields dominate the entire landscape which is punctuated only by small and rather isolated tree groups, not really woodlands, and rarely other by features. A reasonable network of hedges provides for movement of animals across the land, but most are regularly trimmed so that their intrinsic value to invertebrates is regularly curtailed. Most water courses are dry in the summer and in any event are mostly lost beneath hedges.

6.2 Invertebrate data obtained by us during the survey have done more to support this visual impression than they have to alter it. The number of recorded invertebrate species is relatively high, and this certainly reflects an adequate recording effort within the available time window, but the composition of the species assemblage reveals a startling lack of species of conservation interest.

6.3 By definition, such more interesting species are less frequently found than the others in the list and the reason for their rarity, in a great many cases, is vested in their specialist ecologies. A phytophagous (vegetarian) insect that can feed on a wide range of plants is clearly more likely to be widespread in distribution and numerically abundant than one which is restricted to either a single family of plants or perhaps to a single species.

6.4 Finding these species on a site is key to assessing its overall ecological value, but proving an absence is rather more tricky than demonstrating a presence. It is frequently said that an experienced entomologist should be able to find at least one noteworthy species on almost any site in southern Britain, and this is probably true, and so the number of such rare species within the recorded assemblage, as well as an examination of their ecological associations, is also important.

6.5 Several noteworthy species have, in fact, been found in the present survey. However, only two of these truly warrant their status – The Shaded Pug moth and the beetle *Kissophagus hederae*, which is associated with mature ivy. This is a very low total and it is, of course, inevitable that further survey will not only generate a longer species list but also that this might contain further interesting species. However, we are not of the opinion that the conclusions based on the present results would alter if extensive and detailed species listing was indeed undertaken.

6.6 Overall, therefore, we are of the opinion that the survey area supports a bare minimum of invertebrate interest. There are small areas of slightly better invertebrate habitat in the form of tree groups, water bodies and some other habitats and it is these that support the entire of the recorded invertebrate assemblage. These are now briefly discussed.

6.7 Tree groups are few, far between (isolated) and with the exception of compartment T2, apparently of low floral diversity. All appear to be dominated by Ash. The trees, generally, grow close together restricting the ground flora by reducing light penetration. Their boundaries with adjacent fields are mostly abrupt and transitional zones (edge habitats) are generally absent.

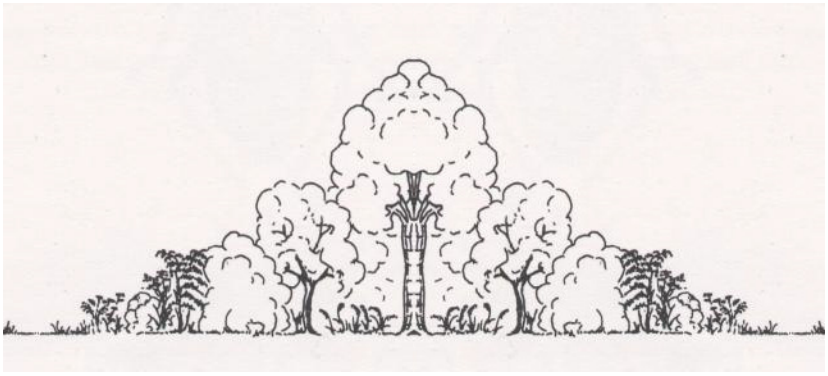
6.8 The single exception to this generalisation is the developing woodland in compartment T2. This is a section of the former main road that has now become isolated and is no longer subjected to management. Trees are growing to maturity, hedges have become overgrown and scrub is marching out from the edges across the former roadside verges where there is a greater diversity of herbs than can be found in most other parts of the site.

6.9 It is unsurprising to discover that this compartment has the highest species total of all the recorded compartments, with precisely 300 listed in Appendix 1. What this shows, quite clearly, is that areas of the site that are neglected – no longer managed – will develop a raised invertebrate value in a relatively short period of time. As if to prove this theorem, another abandoned area of the site, that around Gowell Farm (compartment T1), records the second highest invertebrate species diversity, with 294 taxa listed during 2010. Other areas of the site record significantly reduced species lists.

6.10 The network of hedges on the site is variable in quality. Almost all are either flailed or clipped on an annual basis. However, where hedges have grown very tall, this management is, in some sections, limited to the lower two or three metres; in these situations the uncut tops of the hedges present a better prospect for invertebrates.

6.11 Cutting hedges reduces intrinsic invertebrate interest for several reasons. Clearly, it directly removes the insects themselves. In the summer, this might be the actively feeding adults, whilst in the winter eggs, larvae, pupae and hibernating adults are lost. Since there is no evidence of the arisings being retained on this site, then there is no opportunity for mobile forms to return to the hedge. Additionally, it drastically reduces the food resource of many insects, notably nectar and pollen, by direct removal of flowering potential. As well as this it eliminates the transitional "edge habitat" zone that is of immense importance to invertebrates and other animal groups.

6.12 The best edges are those that are gradual, with the vertical component rising gradually through long grass, tall herbs and larger bushes to mature trees. This is illustrated in the following diagram:



6.13 Such edge habitats provide physical support for migration of invertebrates around the landscape; where the floral component is comprised of native rather than non-native species these edge habitats will also support a raised intrinsic invertebrate interest.

6.14 Most of the hedges on site appear to be poorly structured in this way and, in general, fields seem to be ploughed to within a metre or less of the base of their boundary hedges. They do nevertheless connect otherwise isolated areas of potential interest and their continued presence will be essential in the facilitation of movement of invertebrates around the landscape at Bicester. They ought to be retained and enhanced, or else replaced, in any proposed development.

6.15 Water-bodies on the site are few. Most ponds probably vanished a long time ago; no additional examples can be seen on 1945 aerial photographs. The largest pond currently extant (compartment A6) is entirely artificial, of recent creation and low in aquatic invertebrate interest.

6.16 Of potentially higher invertebrate ecology interest are the flowing water-courses. That which arises more or less on the boundary line of the survey area to the west of Crowmarsh Farm is spring-fed and so flows for most of the year, albeit rather slowly in the summer.

6.17 Most of the others were dry in the summer of 2010 and these may be seasonal features. Seasonal watercourses can develop a small but specialist invertebrate interest; unfortunately this could not be examined within the seasonal window available to us.

# 7 CONCLUSIONS

7.1 Overall, we are not able, on the basis of available data, to raise any specific invertebrate ecology-based objection to the proposed development of the Bicester site other than to comment that the overall reduction of open greenspace is inevitably detrimental to invertebrate ecology at the landscape level.

7.2 Nevertheless, the example of recording compartments T1 and T2 that withdrawal of management from this heavily manicured landscape will permit recolonisation by communities of invertebrates can be drawn upon to increase the value of any ecological mitigation package embarked upon for non-invertebrate reasons.

7.3 In particular, attention to the network of hedges would be valuable. Ideally, the network would be retained within the proposed development and wherever possible a more favourable hedgerow management regime should be installed. Not cutting one side of the hedge is desirable in some places; elsewhere a rotational cutting of hedges such that no section is cut more frequently than once every five years might be appropriate.

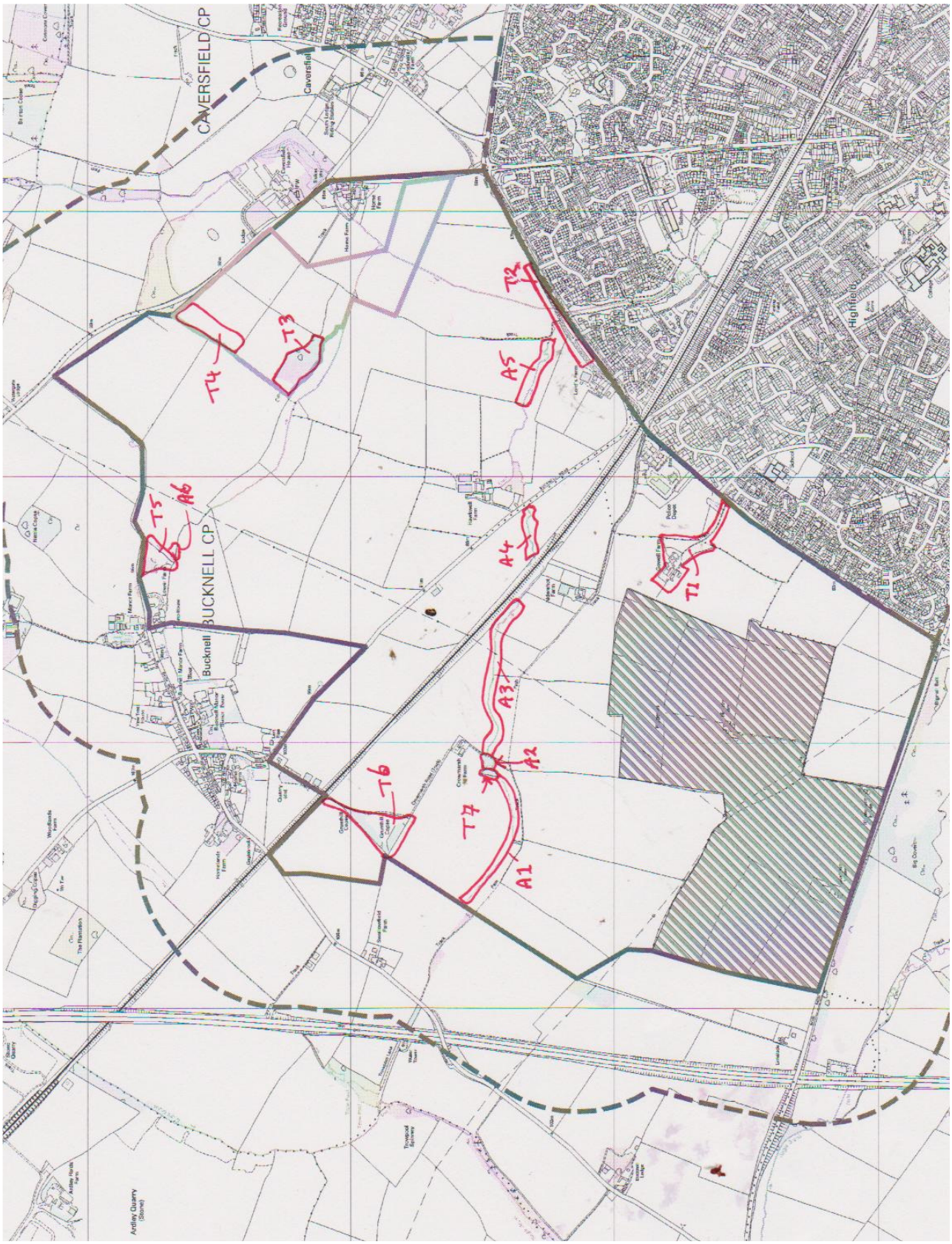
7.4 Retained tree groups could usefully be allowed to expand to occupy larger areas and to develop less well-defined boundaries. Incorporating these into amenity areas might allow for the development of better-structured edge habitats.

## 8 REFERENCES QUOTED IN THIS REPORT AND ITS APPENDICES


| | | |
|---|---|---|
| Bratton, J. H. | 1991 | *British Red Data Books: 3. Invertebrates other than insects*. NCC |
| Shirt, D. B. (ed.) | 1987 | *British Red Data Books: 2. Insects*. NCC |
| UK Biodiversity Group | 1999 | *Tranche 2 action plans. Volume iv - invertebrates*. English Nature. |

# APPENDICES

# MAP 1: THE SURVEYED AREA, SHOWING THE POSITIONS OF THE RECORDING COMPARTMENTS AND THEIR NUMBERS



# APPENDIX 1: TERRESTRIAL INVERTEBRATE SPECIES RECORDED

**National status codes are explained in Appendix 2.**

| Group / species | English name if available | National status | Ecological associations | Where found (see text section 3) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | | | | | | | | | | |
| **ARACHNIDA: ARANEA** | **SPIDERS** | | | | | | | | | | |
| **Araneidae** | | | | | | | | | | | |
| *Araneus diadematus* | the garden spider | | ubiquitous | | | | | | | | + |
| **Linyphiidae** | | | | | | | | | | | |
| *Lepthyphantes tenuis* | a spider | | ubiquitous - often in grassland, but also a pioneer species | + | | | + | | | | |
| *Linyphia triangularis* | a money spider | | almost ubiquitous | + | | | + | | | | |
| **Pisauridae** | | | | + | | | | | | | |
| *Pisaura mirabilis* | a spider | | more or less ubiquitous, but likes tall vegetation | | | | | | | | |
| **ARACHNIDA: ACARI** | **GALL MITES** | | | | | | | | | | |
| **Eriophyidae** | | | | | | | | | | | |
| *Aceria crataegi* | | | causes galls on leaves of hawthorn | + | + | | | | + | | + |
| *Aceria macrorhynchus* | | | makes galls on Sycamore leaves | + | | | | | | | |
| *Aceria pseudoplatani* | | | causes galls on leaves of sycamore | | | | | | | | + |
| *Phyllocoptes goniothorax* | | | causes galls on leaves of hawthorn | + | + | | | | + | | |
| **ARACHNIDA: OPILIONES** | **HARVESTMEN** | | | | | | | | | | |
| **Leiobunidae** | | | | | | | | | | | |
| *Leiobunum rotundum* | | | Ubiquitous - under stones, logs etc | | + | | | | | | |
| **Phalangiidae** | | | | | + | | | | | | |
| *Oligolophus tridens* | | | ubiquitous species | | | | | | | | |
| **COLEOPTERA** | **BEETLES** | | | | | | | | | | |
| **Anobiidae** | | | | | | | | | | | |
| *Anobium punctatum* | | | larvae feed in dead timber | + | + | | | | | | + |
| *Ptilinus pectinicornis* | | | larvae feed in dead tree branches and other dead timber | | + | | | | | | + |
| **Anthicidae** | | | | | | | | | | | |
| *Anthicus antherinus* | | | larvae in decaying grass litter - adults at flowers | | | | | | | + | |
| **Apionidae** | **Seed weevils** | | | | | | | | | | |
| *Apion frumentarium* | | | broad-leaved docks | + | | | | | | | |

| Group / species | English name if available | National status | Ecological associations | Where found (see text section 3) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | | | | | | | | | | |
| *Ceratapion carduorum* | | Local | Thistles | + | | | | | | | |
| *Ceratapion gibbirostre* | | | thistles - in the stems | | + | | | | | + | |
| *Malvapion malvae* | | | Malvaceae - especially Malva sylvestris | | + | | | | | | |
| *Perapion violaceum* | | | dock plants, the larvae mining the stems; widespread and common | + | | | | | | | |
| *Protapion apricans* | | | bird's-foot Trefoil and perhaps other legumes; widespread and common | + | + | | | | | | + |
| *Protapion assimile* | | | clover, especially red clover; widespread and common | | | | | | | | + |
| *Protapion dichroum* | | | Trifolium - widespread and almost ubiquitous | | | | | | | | + |
| *Protapion trifolii* | | | various clovers; widespread and common | | | | | | | | |
| *Trichapion simile* | | | Associated with birch foliage | | + | | | | | | |
| **Byturidae** | | | | | | | | | | | |
| *Byturus tomentosus* | the raspberry beetle | | Brambles and raspberries | + | + | + | | + | + | + | + |
| **Cantharidae** | **Soldier beetles** | | | | | | | | | | |
| *Cantharis cryptica* | | | tall vegetation, especially at the woodland/grassland interface | + | + | + | + | + | + | + | + |
| *Malthinus seriepuncatatus* | | | broad-leaved woodland species | | + | | | | | | + |
| *Malthodes minimus* | | | woodland and scrub | | | | | | | | + |
| *Rhagonycha fulva* | | | tall, rank vegetation in lowland areas | + | + | + | + | + | + | + | + |
| *Rhagonycha lignosa* | | | an arboreal species | + | + | + | | + | + | + | + |
| *Rhagonycha limbata* | | | dry grasslands (formerly called Rhagonycha femoralis) | + | + | | + | | | | |
| **Carabidae** | **Ground beetles** | | | | | | | | | | |
| *Amara (Curtonotus) aulica* | | | dry, well-vegetated sites, the adults climbing stems of Compositae at night to feed on the seed heads | + | | | | | | | |
| *Amara communis* | | | phytophagous species of open sites, hiding under leaf rosettes, stones, etc | + | | | | | | | |
| *Amara familiaris* | | | Phytophagous species of gardens and other open, dry and sunny habitats | + | | | | | | | |
| *Amara lunicollis* | | Local | grasslands, open woodland, gardens etc | + | | | | | | | |
| *Amara similata* | | | phytophagous on ruderal vegetation, especially on waste ground | + | | | | | | | |
| *Bradycellus verbasci* | | | prefers light soils in open situations, including arable | + | | | | | | | |
| *Carabus violaceus* | | | fairly widespread in most habitats | + | | | | | | | |
| *Demetrias atricapillus* | | | amongst leaf litter and in grasslands | + | | | | | | | |
| *Dromius quadrimaculatus* | | | arboreal species of deciduous trees and occasionally on conifers | + | + | | | | + | | |

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| *Harpalus (Ophonus) puncticeps* | | | phytophagous species of open, ruderal habitat | + | | | | | | | |
| *Harpalus (Pseudophonus) rufipes* | | | ubiquitous | + | | | | | | | |
| *Loricera pilicornis* | | | ubiquitous, but especially near water and in damp grassland; feeds on springtails | | | | | + | | + | |
| *Nebria brevicollis* | | | ubiquitous late summer and autumn species | + | | | | | | + | |
| *Notiophilus biguttatus* | | | most open ground habitats | + | | | | | | + | |
| *Pterostichus (Poecilus) cupreus* | | Local | open grassy habitats - usually where damp | + | | | | | | + | |
| *Pterostichus madidus* | | | ubiquitous | + | | | | | | + | |
| *Pterostichus melanarius* | | | ubiquitous | + | | | | | | | |
| *Pterostichus nigrita s. str.* | | | wet, well-vegetated habitats, river banks and damp woodland | + | | | | | | + | |
| *Pterostichus strenuus* | | | most habitats that are not too dry | + | | | | | | | |
| *Trechus quadristriatus* | | | ubiquitous in most open habitats during autumn | + | + | | | | | | |
| **Cerambycidae** | **longhorn beetles** | | | | | | | | | | |
| *Clytus arietis* | | | in dead wood - usually birch or willow, adults at flowers | | + | | | | | | |
| *Grammoptera ruficornis* | | | larvae in twigs and small branches; adults at flowers | | + | | | | | | |
| *Rhagium mordax* | | | larvae feed internally in well-rotten stumps and other timber, especially oak | + | | | | | | | |
| *Tetrops praeustus* | | | feed on a wide variety of deciduous trees | | | | | | + | | + |
| **Chrysomelidae** | **leaf beetles** | | | | | | | | | | |
| *Altica lythri* | | | Associated with various willow-herbs (Onagraceae) | | + | | | | | | |
| *Aphthona euphorbiae* | | Local | widely polyphagous | + | + | + | + | + | + | + | + |
| *Cassida rubiginosa* | | | various thistles, burdock and other Asteraceae | + | | | | | | | |
| *Chaetocnema hortensis* | | | feeds on various grasses | | + | | | | | | |
| *Crepidodera aurata* | | | willows - rarely on poplars | | + | | | | | | |
| *Crepidodera aurea* | | | poplars - occasionally on willows | | + | | | | | | |
| *Crepidodera fulvicornis* | | | Salix species | | + | | | | | | |
| *Crepidodera plutus* | | Local | Willows, especially Crack Willow - rarely on poplars | | + | | | | | | |
| *Galerucella lineola* | | | Alder, Hazel and willows | | + | | | | | | |
| *Gastrophysa viridula* | | | larvae feed on dock leaves in damp meadows and elsewhere | | | | | | | + | |
| *Lochmaea crataegi* | | | Hawthorn - larvae mine the berries. Occasionally on Blackthorn or Rowan | | + | | | | + | | + |
| *Longitarsus flavicornis* | | | ragworts | | | | | | | | + |
| *Longitarsus luridus* | | | widely polyphagous | | | | | | | | + |
| *Longitarsus parvulus* | | | feeds on many plant species | | | | | | | | + |

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| | | | | | | | | | | | |
| *Oulema melanopa s. str.* | | | feeds on grasses - very common | + | | | | | | | + |
| *Phaedon tumidulus* | | | on various Apiaceae, especially cow parsley, angelica, hogweed etc | | | | | | | | + |
| *Phyllodecta (Phratora) vulgatissima* | | | willows and perhaps poplars and Aspen | | + | | | | | | |
| *Phyllodecta (Phratora) vitellinae* | | | willows and poplars, including Aspen | | + | | | | | | |
| *Phyllotreta atra* | | | various Brassicaceae | + | + | | + | | | | |
| *Phyllotreta diademata* | | | various Brassicaceae | | | | + | | | | |
| *Phyllotreta nigripes* | | | various Brassicaceae | | + | | + | | | | |
| *Phyllotreta undulata* | | | various Brassicaceae | + | + | | + | | | | |
| *Plagiodera versicolora* | | | Crack willow and other willows, occasionally Black Poplar | | + | | | | | | |
| *Podagrica fuscicornis* | | NS(Nb) | mallow (Malva species) | | + | | | | | | |
| *Psylliodes chrysocephala* | | Local | various Cruciferae | | + | | | | | | |
| *Psylliodes dulcamarae* | | | Woody nightshade (Solanum dulcamara) | | | | | | | | + |
| *Psylliodes napi* | | | various Cruciferae | + | | | | | | | |
| *Sphaeroderma rubidum* | | | feeds on thistles and other Asteraceae | + | | | | | | | |
| *Sphaeroderma testaceum* | | | mainly on thistles | + | | | | | | | |
| **Ciidae** | | | | | | | | | | | |
| *Cis boleti* | | | fungi - in both brackets and caps | | + | | | | | | + |
| **Coccinellidae** | | | | | | | | | | | |
| *Adalia 10-punctata* | 10-spot ladybird | | predatory on other insects | + | + | | + | + | + | | + |
| *Adalia 2-punctata* | 2-spot ladybird | | predatory on other insects | + | + | + | + | + | + | + | + |
| *Anisostica 19-punctata* | 19-spot ladybird | | wetland habitats | | | | | | | + | |
| *Chilocoris renipustulatus* | kidney-spot ladybird | | trees, especially on willows in wet areas | | + | | | | | | |
| *Coccinella 7-punctata* | 7-spot ladybird | | predatory on other insects | + | + | + | + | + | + | + | + |
| *Halyzia 16-guttata* | Orange ladybird | | predatory on other insects | + | + | + | + | + | + | + | + |
| *Harmonia axyridis* | Harlequin ladybird | | a recent colonist in Britain | + | + | + | + | + | + | + | + |
| *Propylea 14-punctata* | 14-spot ladybird | | predatory on other insects | + | + | + | + | + | + | + | + |
| *Rhyzobius litura* | a spotless ladybird | | predatory on other insects | | | | + | | | | + |
| *Subcoccinella 24 - punctata* | 24-spot ladybird | | predatory on other insects | + | + | + | | + | + | + | + |
| *Thea 22-punctata* | 22-spot ladybird | | feeds on mildews | | | | | | | | |
| **Curculionidae** | **Weevils** | | | | | | | | | | |
| *Anthonomus pedicularis* | | | larvae develop in hawthorn berries | | + | | | | + | | + |
| *Barypeithes araneiformis* | | | ubiquitous amongst moss, litter, etc. | | + | | | | | | |

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| *Ceutorhynchus obstrictus* | | | various Cruciferae | | + | | | | | | |
| *Ceutorhynchus pallidactylus* | | | ecology unclear | | + | | | | | | |
| *Ceutorhynchus pollinarius* | | | Nettles | | + | | | | | | |
| *Cionus scrophulariae* | | | Figworts (Scrophularia species) | | + | | | | | | |
| *Curculio glandium* | | Local | Oak trees | + | | | | | | | + |
| *Curculio pyrrhoceras* | | Local | oak - causing leaf galls | | | | | | | | + |
| *Curculio salicivorus* | | | birch, willow and other trees | | | | | | | | + |
| *Dorytomus taeniatus* | | | the larvae feeds inside the female catkins of willow trees | | + | | | | | | |
| *Dorytomus tortrix* | | Local | in catkins of aspen and sallow | | + | | | | | | |
| *Euophryum confine* | | | dead timber | | + | | | | | | |
| *Gymnetron pascuorum* | | | feeds on flowers of Plantago lanceolata - Ribwort Plantain | | | | | | | | + |
| *Hypera nigrirostris* | | | Trifolium pratense - on the foliage | | | | | | | | + |
| *Hypera postica* | | | Medicago, Melilotus and Trifolium - on the foliage | | | | | | | | + |
| *Hypera rumicis* | | | Rumex species (docks) - on the foliage | | | | | | | | + |
| *Nedyus quadrimaculatus* | | | nettles - feeding on the flowers | | | | | | | | + |
| *Otiorhynchus singularis* | | | feeds on a variety of plant roots | + | | | | | | | |
| *Phyllobius maculicornis* | | Local | polyphagous on leaves of deciduous trees and shrubs | | + | | | | + | + | |
| *Phyllobius oblongus* | | | polyphagous on broad-leaved trees and bushes | | | | | | | | |
| *Phyllobius pomaceus* | | | Nettles | | + | | | | + | | |
| *Phyllobius roboretanus* | | | nettle - feeding on the leaves and flowers | | + | | | | | | |
| *Phyllobius viridiaeris* | | | typically in hedges and other edge habitats | | | | | | | | |
| *Polydrusus cervinus* | | | trees and shrubs - feeding on the leaves | | | | | | | | + |
| *Polydrusus pterygomalus* | | | polyphagous on broad-leaved trees, especially oak | + | | | | | | | |
| *Rhamphus oxyacanthae* | | Local | larva mines in leaves of hawthorn | | + | | | | | | |
| *Rhinoncus castor* | | | Dock plants | | | | | | | | |
| *Rhynchaenus querci* | | | larvae mine the leaves of oak trees | + | + | | | | + | | + |
| *Sitona lineatus* | | | various legumes | + | + | + | + | + | + | + | + |
| *Trichosirocalus troglodytes* | | | Plantains, usually in grassy places | | | | + | | | | + |
| **Dermestidae** | | | | | | | | | | | |
| *Anthrenus verbasci* | | | feeds on dead animal and plant matter, including dry carcasses | | + | | | | | | |
| **Elateridae** | | | | | | | | | | | |
| *Agriotes lineatus* | | | larvae feed on grass roots | | | | + | | | | |
| *Athous (Hemicrepidus) hirtus* | | | grassland, woodland rides, etc. The larvae feed in decaying wood and in soil | | | | | | | | |

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| *Athous haemorrhoidalis* | | | the larva feeds on the roots of grasses | | + | | | | | | |
| *Kibunea (Cidnopus) minuta* | | | a species of dry grasslands | | | | + | | | | |
| **Histeridae** | | | | | | | | | | | |
| *Saprinus semistriatus* | a carrion beetle | | feeds in carrion | + | | | | | | | |
| **Kateretidae** | | | | | | | | | | | |
| *Brachypterus glaber* | | | Nettles | + | + | | + | | | | + |
| *Brachypterus urticae* | | | Nettles | + | + | + | + | | | | + |
| **Latridiidae** | | | | | | | | | | | |
| *Aridius bifasciatus* | | | litter, compost, tussocks etc - more or less ubiquitous | | | | | | | | + |
| *Aridius nodifer* | | | litter, compost, tussocks etc - more or less ubiquitous | | | | | | | | + |
| **Leiodidae** | | | | | | | | | | | |
| *Catops nigricans* | | | carrion | + | | | | | | | |
| **Melyridae** | | | | | | | | | | | |
| *Cordylepherus (Malachius) viridis* | | Local | a common grassland species | + | | | + | | | | + |
| *Malachius bipustulatus* | a malachite beetle | | grasslands | + | | | + | | | | + |
| **Nitidulidae** | | | | | | | | | | | |
| *Glischrochilus hortensis* | | | unknown association; adults usually in woodland | | + | | | | | | |
| *Meligethes aeneus* | a pollen beetle | | various flowers | + | + | + | + | + | + | + | + |
| **Scarabaeidae** | | | | | | | | | | | |
| *Aphodius granarius* | | Local | dung, rotting vegetation (compost heaps) and carcasses | + | | | | | | | |
| **Scolytidae** | | | | | | | | | | | |
| *Kisophagus hederae* | a bark beetle | NS(Nb) | larva feeds in dead ivy wood | | + | | | | | | |
| *Scolytus scolytus* | elm bark beetle | | under elm bark | | | + | | + | + | | |
| **Scraptiidae** | | | | | | | | | | | |
| *Anaspis fasciata (= humeralis)* | | | larvae in twigs of oak and other trees; adults at hawthorn blossom | | + | | | | | | |
| *Anaspis frontalis* | | | larvae in twigs of oak and other trees; adults at hawthorn blossom | | + | | | | | | |
| *Anaspis regimbarti* | | | larvae feed in large girth oak branches and decaying oak trunks | | + | | | | | | |
| **Silphidae** | **Sexton Beetles** | | | | | | | | | | |
| *Necrodes littoralis* | | | carrion | + | | | | | | | |
| *Nicrophorus humator* | | | carrion | + | | | | | | | |
| *Nicrophorus vespilloides* | | Local | carrion | + | | | | | | | |
| **Staphylinidae** | **Rove beetles** | | | | | | | | | | |

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| | | | | | | | | | | | |
| *Aleochara curtula* | | | leaf litter, decaying vegetation etc | + | | | | | | | |
| *Aloconota gregaria* | | | plant litter - ubiquitous | + | | | | | | | |
| *Anotylus inustus* | | | leaf litter, carrion, dung and similar | + | | | | | | | |
| *Anotylus rugosus* | | | a detritus-feeding rove beetle | + | | | | | | | |
| *Anotylus sculpturatus* | | | grass tussocks, litter, dung etc | + | | | | | | | |
| *Atheta (Dimetrota) atramentaria* | | | larvae feed in animal dung - very common | + | | | | | | | |
| *Autalia rivularis* | | | associated with herbivore dung | + | | | | | | | |
| *Lathrobium brunnipes* | | | grass tussocks, litter, dung etc | + | | | | | | | |
| *Ocypus (Tasgius) ater* | | | carrion, dung, etc | + | | | | | | | |
| *Philonthus varius* | | | ubiquitous - in moss, litter, carrion, dung etc | + | | | | | | | |
| *Quedius curtipennis* | | | leaf litter, carrion, dung and similar | + | | | | | | | |
| *Quedius levicollis (= tristis)* | | | ecology unclear | + | | | | | | | |
| *Staphylinus brunnipes* | | | leaf litter, carrion, dung and similar | + | | | | | | | |
| *Tachyporus dispar* | | | a detritus-feeding rove beetle | + | | | | | | | |
| *Tachyporus hypnorum* | | | leaf litter, grass tussocks and similar micro-habitats | + | | | | | | | |
| *Tachyporus solutus* | | | leaf litter, carrion, dung and similar | + | | | | | | | |
| *Xantholinus linearis* | | | leaf litter, grass tussocks and similar micro-habitats | + | | | | | | | |
| **CRUSTACEA: ISOPODA** | **WOODLICE** | | | | | | | | | | |
| **Oniscidae** | | | | | | | | | | | |
| *Oniscus asellus* | | | damp, but not wet, habitats everywhere | + | + | + | + | + | + | + | + |
| **Philosciidae** | | | | | | | | | | | |
| *Philoscia muscorum* | | | under stones etc | + | + | + | + | + | + | + | + |
| **Porcellionidae** | | | | | | | | | | | |
| *Porcellio scaber* | | | under stones etc | | | | | | | | |
| **Trichoniscidae** | | | | + | + | + | + | + | + | + | + |
| *Trichoniscus pusillus* | | | under stones, bark, etc | | + | | | | | | |
| **DERMAPTERA** | | | | | | | | | | | |
| **Forficulidae** | | | | | | | | | | | |
| *Forficula auricularia* | common earwig | | generalist species | + | + | + | + | + | + | + | + |
| **DIPTERA** | | | | | | | | | | | |
| **Agromyzidae** | | | | | | | | | | | |
| *Agromyza alnibetulae* | | | larva mines the leaves of birch trees | + | | | | | | | |
| *Agromyza dipsaci* | | | larva mines leaves of teasel | + | | | | | | | |
| *Agromyza potentillae* | | | mines leaves of Potentilla reptans and other rosaceous plants | | + | | | | | | + |

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| *Amauromyza labiatarum* | | | mines leaves of Lamium album and other labiates | | + | | | | | | |
| *Liriomyza amoena* | | | mines leaves of elder | + | | + | | + | | | + |
| *Phytomyza heracleana* | | | mines leaves of Heracleum spondylium | | + | | | | | | |
| **Asilidae** | **Robber flies** | | | | | | | | | | |
| *Dioctria baumhaueri* | | | predatory -mainly in edge habitats | + | + | | | | | | |
| *Dioctria rufipes* | | | predatory -mainly in edge habitats | + | + | | | | | | |
| *Leptogaster cylindrica* | | | grassland predator | + | + | + | + | + | + | + | + |
| **Cecidomyiidae** | | | | + | + | | | | + | | + |
| *Dasineura crataegi* | | | forms galls on hawthorn | | + | | | | | | |
| *Dasineura marginemtorquens* | | | forms rosette gall on sallows and willows | | + | | | | | | |
| *Iteomyia caprea* | | | larva galls the leaves of sallows | | + | | | | | | |
| *Macrodiplosis volvens* | | | larva feeds on oak leaves causing a gall to form a gall | + | | | | | + | | |
| **Conopidae** | | | | | | | | | | | |
| *Sicus ferrugineus* | | Local | parasitic fly on bumble bees | | | + | + | + | | | + |
| **Dolichopodidae** | | | | | | | | | | | |
| *Chrysotus gramineus* | | | very common grassland species | + | | | | | | + | |
| *Poecilobothrus nobilitatus* | | | aquatic larvae | | | | | | | | |
| **Empididae** | | | | | | | | | | | |
| *Empis (Kritempis) livida* | | | predatory on other flies | + | + | + | + | + | + | + | + |
| *Empis (Xanthempis) trigramma* | | | predatory on other flies | + | + | + | + | + | + | + | + |
| **Lauxaniidae** | | | | | | | | | | | |
| *Sapromyzosoma 4-punctata* | | | saprophagous species usually in woodland | | + | | | | | | |
| *Tricholauxania praeusta* | | | larvae feed amongst decaying vegetation in damp, shady places | | + | | | | | | |
| **Limoniidae** | | | | | | | | | | | |
| *Austrolimnophila ochracea* | | | woodland - even small ones- the larvae feeding in dead wood | | | | | | | + | |
| *Cheilotrichia cinerascens* | | | damp places | | + | | | | | + | |
| *Limonia nubeculosa* | a cranefly | | woodland - the larvae feeding in leaf litter | | + | | | | | | |
| *Limonia tripunctata* | | | lowland deciduous woodland, the larvae developing in the soil/litter | | + | | | | | | |
| *Molophilus griseus* | | | damp hedgerows, ditches and woodland | | + | | | | | | |
| *Rhipidia (Limonia) duplicata* | | | various habitats, including woodland and grassland, the larvae feeding in animal dung | + | | | | | | | + |
| **Lonchopteridae** | | | | | | | | | | | |
| *Lonchoptera furcata* | | | a more or less ubiquitous species in edge habitats | | + | | | | | | |

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| *Lonchoptera lutea* | | | ubiquitous species in edge habitats, saprophagous larvae | | + | | | | | + | + |
| **Platystomatidae** | | | | | | | | | | | |
| *Platystoma seminationis* | | | larvae develop in decaying vegetable matter | + | | | | | | | |
| **Ptychopteridae** | | | | | | | | | | | |
| *Ptychoptera albimana* | | | damp habitats, including seepages | | | | | | | | |
| **Rhagionidae** | | | | | | | | | | | |
| *Rhagio lineola* | | | woodland and scrub - especially at the edges | | | | | | | + | |
| *Rhagio scolopaceus* | | | woodland edge and other wooded areas - in clearings and at edges | | + | | | | | | + |
| *Rhagio tringarius* | | | damp habitats | | | | | | | + | |
| **Sepsidae** | | | | | | | | | | | |
| *Nemopoda nitidula* | | | shade-loving species, larvae in dung and carrion | + | | | | | | | |
| *Sepsis fulgens* | | | the most ubiquitous member of this group, feeding in mammal dung | + | | | | | | | |
| **Stratiomyidae** | **Soldier flies** | | | | | | | | | | |
| *Beris chalybata* | | | associated with the scrub/grassland interface | + | + | + | + | + | + | + | + |
| *Beris vallata* | | | larvae require decomposing organic matter | + | + | + | + | + | + | + | + |
| *Chloromyia formosa* | | | ubiquitous | + | + | + | + | + | + | + | + |
| *Chorisops tibialis* | | | larvae require decomposing organic matter | | + | | | | | + | + |
| *Microchrysa polita* | | | larvae require decomposing organic matter | | + | | | | | | + |
| *Oplodontha viridula* | | Local | marshes and pond margins | | | | | | | + | |
| *Pachygaster atra* | | | woodland edge & scrubland species - larvae under dead bark of trees | | + | + | | + | + | | |
| *Pachygaster leachii* | | | woodland edge & scrubland species - larvae under dead bark of trees | | + | | | | | | + |
| *Sargus iridatus* | | | larvae feed in rotting vegetation and similar material | | | | | | | | |
| **Syrphidae** | **Hoverflies** | | | | | | | | | | |
| *Baccha elongata* | | | shaded woodland | | + | | | | | | |
| *Cheilosia albitarsis/ranunculi female* | | | | + | | | | | | | |
| *Cheilosia pagana* | | | larvae are thought to feed in the roots of Anthriscus sylvestris | | + | | | | | | |
| *Chrysotoxum bicinctum* | | | grassland species -associated with ants' nests | + | | | + | | | | + |
| *Dasysyrphus albostriatus* | | | aphid predator at woodland edge habitats | | + | | | | | | |
| *Dasysyrphus tricinctus* | | | aphid predator at woodland edge habitats | | + | | | | | | |
| *Epistrophe eligans* | | | mainly at edge habitats | + | + | + | + | + | + | + | + |

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| *Episyrphus balteatus* | | | ubiquitous species, partly immigrant, and a predator of aphids | + | + | + | + | + | + | + | + |
| *Eristalis arbustorum* | | | Larvae require damp habitats but adults are more or less ubiquitous | + | + | + | + | + | + | + | + |
| *Eristalis nemorum* | | | Larvae require damp habitats but adults are more or less ubiquitous | | + | | | | | | |
| *Eristalis pertinax* | | | Larvae require damp habitats but adults are more or less ubiquitous | + | + | + | + | + | | + | + |
| *Eristalis tenax* | | | Larvae require damp habitats but adults are more or less ubiquitous | + | + | + | | + | + | + | + |
| *Eupeodes corollae* | | | Grassland | + | + | + | + | + | + | + | + |
| *Eupeodes luniger* | | | Grassland | + | + | + | + | + | + | + | + |
| *Helophilus pendulus* | | | Larvae require damp habitats but adults are more or less ubiquitous | + | + | + | + | + | + | + | + |
| *Melanostoma mellinum* | | | Grassland | + | + | + | + | + | + | + | + |
| *Melanostoma scalare* | | | Grassland | + | | | + | | | | |
| *Myathropa florea* | | | larvae are semi-aquatic | | | | | | | + | |
| *Neoascia podagrica* | | | edge-habitat species | + | + | | + | | + | + | + |
| *Pipizella viduata* | | | Larvae feed on root aphids on Umbelliferae | | | | | | | | + |
| *Platycheirus albimanus* | | | ubiquitous - larvae prey on aphids | + | + | + | + | + | + | + | + |
| *Platycheirus clypeatus s. str.* | | | Damp habitats | | | | | | | + | |
| *Platycheirus scutatus s. str.* | | | an edge-habitat species | | + | | | | | | |
| *Rhingia campestris* | | | Cow dung | + | | | | | | | |
| *Sphaerophoria scripta* | | | Grassland | + | + | + | + | + | + | + | + |
| *Syritta pipiens* | | | larvae in decaying vegetation; adults at flowers | + | + | + | + | + | + | + | + |
| *Syrphus ribesii* | | | larvae are aphid predators on trees and bushes | + | + | + | + | + | + | + | + |
| *Syrphus vitripennis* | | | larvae are aphid predators on trees and bushes | + | + | + | + | + | + | + | + |
| *Volucella bombylans* | | | inquiline in nests of bumble bees | | + | | | | | | |
| *Volucella pellucens* | | | inquiline in nests of social wasps/hornet | | + | | | | | | |
| *Xylota segnis* | | | Damp, dead wood | | + | | | | | | |
| **Tabanidae** | | | | | | | | | | | |
| *Haematopota pluvialis* | | | damp habitats - adult females are blood sucking horseflies | + | | | | | + | + | |
| **Tachinidae** | | | | | | | | | | | |
| *Eriothrix rufomaculata* | | | larva parasitises moth larvae | + | + | + | + | + | + | + | + |
| **Tephritidae** | | | | | | | | | | | |
| *Anomoia purmunda* | | Local | Larva feeds in the flesh of hawthorn berries | + | + | | | | + | | + |

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| *Euleia heraclei* | | | white-flowering Umbelliferae | + | | | | | | | |
| *Terellia ruficauda* | | | larvae gall the flowers of thistles | + | | | | | | | |
| *Urophora cardui* | | | larvae gall the flowers of thistles | + | | | | | | | |
| *Xyphosia miliaria* | | | larvae gall the flowers of thistles - ubiquitous | + | | | | | | | |
| **Tipulidae** | **craneflies** | | | | | | | | | | |
| *Savtshenkia pagana* | | | more or less ubiquitous | | + | | | | | | |
| *Tipula oleracea* | | | ubiquitous, larvae feeding on roots of grasses | + | + | + | + | + | + | + | + |
| *Tipula paludosa* | | | ubiquitous, larvae feeding on roots of grasses | + | + | + | + | + | + | + | + |
| **HETEROPTERA** | | | | | | | | | | | |
| **Acanthosomatidae** | | | | | | | | | | | |
| *Acanthosoma haemorrhoidale* | hawthorn shield bug | | hawthorn | | + | | | | + | | + |
| *Elasmucha grisea* | | | birch, occasionally alder | + | | | | | | | |
| **Anthocoridae** | | | | | | | | | | | |
| *Anthocoris confusus* | | | trees and shrubs | + | + | | | | | | |
| *Anthocoris nemoralis* | | | trees and shrubs | + | + | + | | + | + | + | + |
| *Anthocoris nemorum* | | | low vegetation | + | + | + | + | + | + | + | + |
| **Cimicidae** | | | | | | | | | | | |
| *Orius niger* | | | low vegetation on a variety of dry sites | | | | + | | | | |
| **Coreidae** | | | | | | | | | | | |
| *Coriomeris denticulatus* | | | various legumes | + | | | + | | | | |
| **Cydnidae** | | | | | | | | | | | |
| *Legnotus limbosus* | | | Bedstraws | | + | | | | | | |
| **Lygaeidae** | | | | | | | | | | | |
| *Chilacis typhae* | | | Reedmace - in the flower heads | | | | | | | + | |
| *Drymus brunneus* | a plant bug | | amongst litter or moss in damp or shaded places | | + | | | | | | |
| *Heterogaster urticae* | | | Nettles | + | + | + | + | + | + | + | + |
| *Kleidocerys resedae* | | | trees and shrubs generally | + | + | | | + | | | |
| *Scolopostethus affinis* | | | usually on nettles | + | | | | | | | |
| **Miridae** | | | | | | | | | | | |
| *Adelphocoris lineolatus* | | | leguminous plants | + | | | | | | | |
| *Blepharidopterus angulatus* | | | a wide range of broad-leaved trees | | + | | | | | | |
| *Capsus ater* | | | Grassland | + | | | + | | | | |
| *Cyllecoris histrionicus* | | | associated with oak | + | | | | | + | | |
| *Deraeocoris lutescens* | | | predatory amongst trees and bushes | + | + | + | | + | + | + | |

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| *Deraeocoris ruber* | | | nettles, brambles as similar rough vegetation | + | + | + | | + | + | + | |
| *Dicyphus epilobii* | | | Epilobium hirsutum | | + | | | | | | |
| *Dryophilocoris flavo-4-maculatus* | | | associated with oak | + | | | + | | | | |
| *Harpocera thoracica* | | | Oaks -solitary and in woods | + | | | + | | | | |
| *Heterotoma meriopterum* | | | edge habitats - especially in association with nettles | + | | | | | | | |
| *Leptoterna dolabrata* | | | found in a wide range of grassland habitats | + | + | | + | | | | + |
| *Liocoris tripustulatus* | | | stinging nettle | + | + | | + | | | | |
| *Megalocoleus molliculus* | | | a common plant bug associated with Yarrow | + | | | | | | | |
| *Miris striatus* | | | associated with oak | + | | | | + | | | |
| *Notostira elongata* | | | grasslands | | | | | | | | |
| *Orthotylus marginalis* | | | willow trees, occasionally alder and apple trees | | + | | | | | | |
| *Pantilus tunicatus* | | | alder and birch - on the catkins | + | | | | | | | |
| *Phylus melanocephalus* | | | restricted to oak trees | | | | | + | | | |
| *Phytocoris varipes* | | | dry, open grasslands are preferred. Partly vegetarian and partly a predator | | | | + | | | | |
| *Plagiognathus arbustorum* | | | polyphagous, but usually associated with stinging nettles | + | | | | | | | |
| *Stenodema laevigatum* | | | grasslands | + | | | + | | | | + |
| *Stenotus binotatus* | | | grasslands | + | | | + | | | | + |
| **Nabidae** | | | | | | | | | | | |
| *Himacerus apterus* | a damsel bug | | a tree-dwelling species | | + | | | | | | |
| *Nabis ferus* | | | dry sites, especially ruderal grassland | | | | + | | | | |
| **Pentatomidae** | | | | | | | | | | | |
| *Aelia acuminata* | | | Thistles | | | | + | | | | |
| *Dolycoris baccarum* | | | polyphagous species of dry habitats | | | | + | | | | |
| *Eysarcoris fabricii* | | | probably polyphagous | | + | | | | | | |
| *Palomena prasina* | | | trees and shrubs | + | + | | | + | + | + | + |
| *Pentatoma rufipes* | The Forest Bug | | tree-dwelling predator that often flies far from woodland | + | + | | | | | | |
| *Troilus luridus* | a plant bug | | a predator on broad leaved trees and occasionally on pines | | + | | | | | | |
| **Tingidae** | | | | | | | | | | | |
| *Physatocheila dumetorum* | a lacebug | | hawthorn | | + | | | | + | | + |
| *Tingis ampliata* | | | creeping thistle | | | | | | | | + |
| *Tingis cardui* | | | spear thistle - Cirsium vulgare | | | | | | | | + |
| **HOMOPTERA: AUCHENORHYNCHA** | **FROGHOPPERS** | | | | | | | | | | |

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| **Cercopidae** | | | | | | | | | | | |
| *Aphrophora alni* | a froghopper | | larvae feed under froth on a wide range of trees and shrubs | | + | | | | | | |
| *Neophilaenus campestris* | | | dry, open grassland | | | | + | | | | + |
| *Philaenus spumarius* | spittle-bug/Cuckoo-spit bug | | larvae feed under froth on a wide range of herbaceous plants | + | + | + | + | + | + | + | + |
| **Cicadellidae** | | | | | | | | | | | |
| *Cicadella viridis* | | | grasses and rushes in marshy places | | | | | | | + | |
| *Iassus lanio* | | | usually on oak, occasionally on other trees | + | | | | | | | |
| *Oncopsis tristis* | | | birch trees | + | | | | | | | |
| **Cixiidae** | | | | | | | | | | | |
| *Tachycixius pilosus* | | | grasses | | + | | + | | | | |
| **Delphacidae** | | | | | | | | | | | |
| *Stenocranus minutus* | | | grasses in a range of habitats | | | | | | | + | |
| **Issidae** | | | | | | | | | | | |
| *Issus coleoptratus* | | | various tree species | | + | | | | | | |
| **Ledridae** | | | | | | | | | | | |
| *Ledra aurita* | Hippopotamus froghopper | Local | Oak trees | | | | | + | | | |
| **HOMOPTERA: STENORHYNCHA** | **HOPPERS AND APHIDS** | | | | | | | | | | |
| **Aphididae** | | | | | | | | | | | |
| *Dysaphis crataegi agg.* | | | forms galls on hawthorn | + | + | | | | + | | |
| **HYMENOPTERA: ACULEATA** | **BEES, WASPS AND ANTS** | | | | | | | | | | |
| **Apidae** | | | | | | | | | | | |
| *Andrena bicolor* | | | open woodland and grassland - nests in the ground | | | | | | | | + |
| *Andrena flavipes* | a solitary bee | Local | nests colonially, usually tunnelling into in a vertical face, in dry sandy sites | | | | | | | | + |
| *Bombus lapidarius* | red-tailed bumble bee | | ubiquitous | + | + | + | + | + | + | + | + |
| *Bombus lucorum* | white-tailed bumble bee | | ubiquitous | + | + | + | + | + | + | + | + |
| *Bombus pascuorum* | common carder bee | | ubiquitous | + | + | + | + | + | + | + | + |
| *Bombus pratorum* | a bumble bee | | ubiquitous | | + | | | | | | |
| *Bombus terrestris* | buff-tailed bumble bee | | ubiquitous | + | + | + | + | + | + | + | + |
| *Halictus rubicundus* | | | ground nesting solitary bee | | + | | | | | | |
| *Halictus tumulorum* | | | ground-nesting solitary bee in a range of habitats | | + | | | | | | |

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| *Hylaeus annularis* | a yellow-faced bee | Local | nests in hollow plant stems, such as docks, etc | | + | | | | | | |
| *Lasioglossum leucopus* | | Local | excavates nest burrow in level ground - preferring ruderal sites | | + | | + | | | | + |
| *Lasioglossum morio* | | | excavates nest burrows in level ground | + | + | | | | | | |
| *Lasioglossum smeathmanellum* | | | excavates nest burrows in level ground | | + | | | | | | + |
| *Osmia rufa* | | | a red mason bee - nests in holes in trees or hard vertical cliffs | + | | | | | | | |
| **Chrysididae** | | | | | | | | | | | |
| *Chrysis ignita* | Ruby-tailed wasp | | cleptoparasitic on eumenid wasps, especially *Ancistrocerus* species | | + | | | | | | |
| **Eumenidae** | | | | | | | | | | | |
| *Ancistrocerus trifasciatus* | | | nests in dead plant stems | + | | | | | | | |
| **Formicidae** | | | | | | | | | | | |
| *Lasius niger s. str.* | common black ant. | | generalist species | + | + | | + | | | | + |
| *Myrmica rubra* | a red ant | | ubiquitous | + | + | | | | | | + |
| **Sphecidae** | | | | | | | | | | | |
| *Trypoxylon attenuatum* | | | preys on spiders. Nests in plant stems, beetle tunnel or other cavities | | + | | | | | | |
| **Vespidae** | | | | | | | | | | | |
| *Vespula germanica* | a common social wasp | | ubiquitous | | + | | | | | | + |
| *Vespula vulgaris* | a common social wasp | | ubiquitous | | | | | | | + | + |
| **HYMENOPTERA: PARASITICA** | **GALL WASPS** | | | | | | | | | | |
| **Cynipidae** | | | | | | | | | | | |
| *Andricus curvator* | | | forms a gall on an oak leaf | + | | | | | + | | |
| *Andricus kollari* | | | forms the oak marble gall | + | | | | | + | | |
| *Andricus ostreus* | | | forms a gall on an oak leaf | + | | | | | + | | |
| *Biorhiza pallida* | | | forms the oak apple gall | + | | | | | + | | |
| *Cynips divisa* | | | forms a gall on oak | + | | | | | + | | |
| *Neuroterus numismalis* | | | forms the button spangle gall on oak leaves | | | | | | + | | |
| *Neuroterus quercusbaccarum* | | | forms the hairy spangle gall on oak leaves | + | | | | | + | | |
| *Neuroterus tricolor* | | | causes galls on oak leaves | | | | | | + | | |
| **HYMENOPTERA: SYMPHYTA** | **SAWFLIES** | | | | | | | | | | |
| **Argidae** | | | | | | | | | | | |
| *Arge ochropus* | | | larvae feed on wild rose | | | | | | + | | |

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| *Arge ustulata* | | | sallow, birch and hawthorn are all recorded as foodplants | | + | | | | | | |
| **Cephidae** | | | | | | | | | | | |
| *Calameuta pallipes* | | | a grassland sawfly | + | | | | | | | |
| *Cephus cultratus* | | | larvae mine the stems of grasses | | | | + | | | | |
| *Cephus pygmaeus* | | | larvae mine the stems of grasses | + | | | + | | | | |
| **Tenthredinidae** | | | | | | | | | | | |
| *Aglaostigma aucupariae* | | | larvae feed on bedstraws | | | | | | | | |
| *Athalia cordata* | | | ubiquitous sawfly species | + | | | | | | | |
| *Athalia liberta* | | | ubiquitous sawfly species | | + | | | | | | |
| *Dolerus niger* | | | ubiquitous sawfly species | | + | | | | | | |
| *Nematus ribesii* | | | ubiquitous sawfly species | | + | | | | | | |
| *Pontania bridgmannii* | | | larva causes galls on sallow leaves | | + | | | | | | |
| *Profenusa pygmaea* | | | larva mines the leaves of oak trees | | + | | | | + | | |
| *Tenthredo livida* | | | ubiquitous sawfly species | | + | | | | | | |
| **LEPIDOPTERA:** | **BUTTERFLIES** | | | | | | | | | | |
| **Hesperiidae** | | | | | | | | | | | |
| *Thymelicus sylvestris* | Small skipper | | grassland | + | | | | | | | |
| **Lycaenidae** | | | | | | | | | | | |
| *Celastrina argiolus* | Holly blue | | both holly and ivy are required - as there are two generations per year | | + | | | | | | |
| *Polyommatus icarus* | Common blue | | various legumes, especially Bird's-foot Trefoil | + | | | | | | | |
| *Quercusia quercus* | Purple Hairstreak | | oak trees - including isolated examples | + | | | | | | | |
| *Satyrium w-album* | White-letter Hairstreak | | Elm – feeding on suckers as well as mature trees | | | | | | | | + |
| **Nymphalidae** | | | | | | | | | | | |
| *Aglais urticae* | Small tortoiseshell | | larvae feed on Stinging Nettle | | | | | | | | + |
| *Coenonympha pamphilus* | Small Heath | BAP | grassland | + | | | | | | | |
| *Cynthia cardui* | Painted lady | | immigrant species | + | | | | | | | + |
| *Inachis io* | Peacock | | nettles | | + | | | | | | |
| *Maniola jurtina* | Meadow brown | | grassland species | | + | | + | | | | |
| *Pararge aegeria* | Speckled wood | | grasses in light woodland or scrub | | + | | | | | | |
| *Polygonia c-album* | Comma | | nettles | + | | | | | | | |
| **Pieridae** | | | | | | | | | | | |
| *Pieris napi* | Green-veined white | | ubiquitous | + | | | | | | | |
| *Pieris rapae* | Small white | | ubiquitous | + | | | | | | | |

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| **LEPIDOPTERA:** | **MOTHS** | | | | | | | | | | |
| **Agonoxenidae** | | | | | | | | | | | |
| *Blastodacna hellerella* | | | hawthorn - in the berries | | | | | | + | | |
| **Arctiidae** | | | | | | | | | | | |
| *Eilema complana* | Scarce Footman | | lichens - especially on trunks, fences etc | | + | | | | | | |
| *Tyria jacobaeae* | Cinnabar | BAP(R) | Ragwort | + | | | | | | | |
| **Bucculatricidae** | | | | | | | | | | | |
| *Bucculatrix ulmella* | | | oak | + | | | | | | | |
| **Choreutidae** | | | | | | | | | | | |
| *Anthophila fabriciana* | Nettle-tap | | nettles | | + | | | | | | |
| **Coleophoridae** | | | | | | | | | | | |
| *Coleophora flavipennella* | | | oak | + | | | | | | | |
| *Coleophora lutipennella* | | | oak | + | | | | | | | |
| **Drepanidae** | | | | | | | | | | | |
| *Cilix glaucata* | Chinese Character | | blackthorn, hawthorn and other rosaceous bushes | | + | | | | | | |
| **Gelechiidae** | | | | | | | | | | | |
| *Teleiodes luculella* | | | oak | + | | | | | | | |
| **Geometridae** | | | | | | | | | | | |
| *Biston betularia* | Peppered Moth | | deciduous trees and herbaceous plants | | + | | | | | | |
| *Cabera exanthemata* | Common Wave | | Salix species and aspen | | + | | | | | | |
| *Colostygia pectinataria* | Green Carpet | | bedstraws | + | + | | | + | + | + | |
| *Cosmorhoe ocellata* | Purple Bar | | bedstraws | + | | | | | | | |
| *Crocallis elinguaria* | Scalloped Oak | | deciduous trees | | + | | | | | | |
| *Ecliptopera silaceata* | Small Phoenix | BAP(R) | willow herbs, enchanter's nightshade | | + | | | | | | |
| *Epirrhoe alternata* | Common Carpet | | bedstraws | + | + | | | + | + | + | |
| *Eupithecia centaureata* | Lime-speck Pug | | various flowers | + | + | | | + | + | + | |
| *Eupithecia subumbrata* | Shaded Pug | NS(Nb) | herbaceous plants | | | | + | | | | |
| *Eupithecia vulgata* | Common Pug | | herbaceous plants | + | + | | | | + | | |
| *Hydriomena furcata* | July Highflier | | Salix species | + | + | | | + | + | + | |
| *Idaea aversata* | Riband wave | | herbaceous plants - especially bedstraws | + | + | | | + | + | + | |
| *Idaea biselata* | Small Fan-footed Wave | | dandelion, plantain, Polygonum etc | | + | | | | | | |
| *Lomaspilis marginata* | Clouded Border | | sallow, willow, poplar - rarely hazel | | + | | | | | | |
| *Opisthograptis luteolata* | Brimstone Moth | | deciduous trees | | + | | | | | | |
| *Peribatodes rhomboidaria* | Willow Beauty | | deciduous trees | + | + | | | | | + | |

| Group / species | English name if available | National status | Ecological associations | Where found (see text section 3) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | | | | | | | | | | |
| *Xanthorhoe montanata* | Silver-ground Carpet | | herbaceous plants - especially bedstraws | + | + | | | | | | |
| *Xanthorhoe spadicearia* | Red Twin-spot Carpet | | herbaceous plants - especially bedstraws | + | | | | | | | |
| **Gracillariidae** | | | | | | | | | | | |
| *Acrocercops brongniardella* | | | mines leaves of oak | + | | | | | + | | |
| *Aspilapteryx tringipennella* | | | Ribwort plantain | | + | | | | | | |
| *Caloptilia robustella* | | | oak | + | + | | | | | | |
| *Caloptilia stigmatella* | | | sallow and poplar | | + | | | | | | |
| *Caloptilia syringella* | | | caterpillar mines leaves of ash, hawthorn or lilac | | + | + | | + | + | + | |
| *Cameraria ohridella* | | | larva mines the leaves of Horse Chestnut - a recent colonist in Britain, from Europe | | | | | | | | + |
| *Parornix anglicella* | | | mines leaves of hawthorn | + | + | | | + | + | | |
| *Parornix finitimella* | | | Blackthorn | + | | | | | | | |
| *Phyllonorycter acerifoliella* | = sylvella | | mines leaves of field maple | | + | | | | + | | |
| *Phyllonorycter blancardella* | | | mines leaves of apple | + | | | | | | | |
| *Phyllonorycter cerasicolella* | | | mines leaves of cherry | | + | | | | | | |
| *Phyllonorycter corylifoliella* | | | mines leaves of hawthorn and other rosaceous shrubs, rarely on birch | + | + | | | | + | | + |
| *Phyllonorycter geniculella* | | | mines leaves of sycamore | + | | | | | | | + |
| *Phyllonorycter harrisella* | | | mines leaves of oak | + | | | | | + | | + |
| *Phyllonorycter maestingella* | | | mines leaves of beech | | | | | | + | | |
| *Phyllonorycter messaniella* | | | mines leaves of oak, beech, hornbeam and sweet chestnut | + | | | | | + | | |
| *Phyllonorycter oxyacanthae* | | | mines leaves of hawthorn and other rosaceous shrubs | | + | | | | + | | |
| *Phyllonorycter platanoidella* | | NS(Nb) | mines leaves of Norway Maple | + | | | | | | | |
| *Phyllonorycter quercifoliella* | | | mines leaves of oak | + | | | | | + | | |
| *Phyllonorycter salicicolella* | | | mines leaves of willows | | + | | | | | | |
| *Phyllonorycter spinicolella* | | | mines leaves of blackthorn | + | | | | | | | |
| *Phyllonorycter trifasciella* | | | mines leaves of honeysuckle and snowberry | | + | | | | | | |
| *Phyllonorycter tristrigella* | | | mines leaves of elm | | | + | | + | + | | |
| *Phyllonorycter ulmifoliella* | | | mines leaves of birch | + | | | | | | | |
| **Hepialidae** | | | | | | | | | | | |
| *Hepialus humuli* | Ghost Moth | BAP(R) | roots of grasses and herbaceous plants | + | | | | | | | |
| **Lyonetiidae** | | | | | | | | | | | |
| *Lyonetia clerkella* | | | mines leaves of rosaceous bushes and trees, birch etc | + | + | | | | | | |
| **Momphidae** | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | | | | | | | |
| *Mompha ochraceella* | | | willow-herbs, mining the leaves | | + | | | | | | |
| *Mompha raschkiella* | | | Rosebay Willow-herb - mining the leaves | | + | | | | | | |
| **Nepticulidae** | | | | | | | | | | | |
| *Ectoedemia atricollis* | | | rosaceous trees, especially hawthorn, mining the leaves | + | + | | | | + | | + |
| *Ectoedemia subbimaculella* | | | larva mines leaves of oak | | | | | | + | | |
| *Stigmella anomalella* | | | mines leaves of rose | | | | | | + | | |
| *Stigmella atricapitella* | | | mines leaves of oak | + | | | | | + | | |
| *Stigmella aurella agg.* | | | mines leaves of bramble | + | + | + | | + | + | + | + |
| *Stigmella basiguttella* | | | mines leaves of oak | + | | | | | | | |
| *Stigmella crataegella* | | | mines leaves of hawthorn | + | + | | | | | | + |
| *Stigmella hybnerella* | | | mines leaves of hawthorn | + | | | | | + | | + |
| *Stigmella oxyacanthella* | | | mines leaves of hawthorn | + | + | | | | + | | + |
| *Stigmella plagicolella* | | | mines leaves of blackthorn | + | | | | | | | |
| *Stigmella roborella* | | | mines leaves of oak | | | | | | + | | |
| *Stigmella ruficapitella* | | | mines leaves of oak and perhaps Sweet Chestnut | + | | | | | + | | |
| *Stigmella salicis* | | | mines leaves of willow and sallow | | + | | | | | | |
| *Stigmella samiatella* | | pRDB3 | mines leaves of Sweet Chestnut | + | | | | | | | |
| *Stigmella speciosa* | | | mines leaves of sycamore | + | | | | | | | |
| *Stigmella tityrella* | | | mines leaves of beech | | | | | | + | | |
| **Noctuidae** | | | | | | | | | | | |
| *Abrostola tripartita* | Spectacle | | nettles | + | + | | | | | + | |
| *Acronicta aceris* | Sycamore | | Horse Chestnut, Sycamore and other deciduous trees | + | | | | | | | |
| *Agrochola lychnidis* | Beaded Chestnut | BAP(R) | deciduous trees and shrubs and herbaceous plants (requires both) | + | + | | | | | | |
| *Agrotis exclamationis* | Heart and Dart | | herbaceous plants | + | + | | | + | + | + | |
| *Agrotis puta* | Shuttle-shaped Dart | | herbaceous plants | + | + | | | + | | | |
| *Allophyes oxyacanthae* | Green Brindled Crescent | BAP(R) | rosaceous trees and shrubs | | + | | | | | | |
| *Amphipyra pyramidea* | Copper Underwing | | deciduous trees and bushes | | + | | | | | | |
| *Apamea lithoxylaea* | Light Arches | | grasses | + | | | | | | | |
| *Apamea monoglypha* | Dark Arches | | grasses | + | + | | | + | + | + | |
| *Atethmia centrago* | Centre-barred Sallow | BAP(R) | ash - buds then flowers | + | + | | | + | + | + | |
| *Autographa gamma* | Silver Y | | nettles and other herbaceous plants - rarely surviving winter. Immigrants from Europe are regular | + | | | | | | | + |
| *Axylia putris* | Flame | | herbaceous plants | + | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | | | | | | | |
| *Cosmia pyralina* | Lunar-spotted Pinion | | deciduous trees and bushes | | | + | | | | | |
| *Cosmia trapezina* | Dun-bar | | deciduous trees | + | + | | | + | | | |
| *Diachrysia chrysitis* | Burnished Brass | | nettles and other herbaceous plants | + | + | | | | | | |
| *Discestra trifolii* | Nutmeg | | Atriplex and Chenopodium | + | | | | | | | |
| *Gortyna flavago* | Frosted Orange | | in the stems of thistle, burdock and similar plants | + | | | | | | | |
| *Hoplodrina alsines* | Uncertain | | herbaceous plants | + | + | | | + | + | + | |
| *Hoplodrina ambigua* | Vines Rustic | | herbaceous plants - especially dandelions | + | + | | | + | + | + | |
| *Hydraecia micacea* | Rosy Rustic | BAP(R) | herbaceous plants, especially docks, feeding in the rootstock | + | | | | | | | |
| *Hypena proboscidalis* | Snout | | nettles | + | | | | | | | + |
| *Lacanobia oleracea* | Bright-line Brown-eye | | herbaceous plants | | | | | + | | | |
| *Melanchra persicariae* | Dot Moth | BAP(R) | herbaceous plants | + | | | | | | | |
| *Mesapamea didyma* | Lesser Common Rustic | | grasses | | | | | | + | + | |
| *Mesapamea secalis* | Common Rustic | | grasses | + | + | | | | + | | |
| *Mesoligia furuncula* | Cloaked Minor | | grasses | + | | | | | | | |
| *Mythimna impura* | Smoky Wainscot | | grasses | + | | | | | | | + |
| *Mythimna pallens* | Common Wainscot | | grasses | + | | | | | | | |
| *Noctua comes* | Lesser Yellow Underwing | | herbaceous plants | + | + | | | + | + | + | |
| *Noctua janthe* | Lesser Broad-bordered Yellow U | | herbaceous plants | + | + | | | + | + | + | |
| *Noctua pronuba* | Large Yellow Underwing | | herbaceous plants | + | + | | | + | + | + | |
| *Nycteola revayana* | Oak Nycteoline | | oak leaves | + | | | | | | | |
| *Ochropleura plecta* | Flame Shoulder | | herbaceous plants | | + | | | | + | | |
| *Oligia latruncula* | Tawny Marbled Minor | | grasses | + | + | | | | | | |
| *Omphaloscelis lunosa* | Lunar Underwing | | grasses | + | | | | | | | |
| *Phlogophora meticulosa* | Angle Shades | | herbaceous plants | + | | | | | | | |
| *Rivula sericealis* | Straw Dot | | grasses - especially Brachypodium species | + | + | | | | | + | |
| *Xanthia icteritia* | Sallow | BAP(R) | sallow/willow catkins - then on herbaceous plants | | + | | | | | | |
| *Xanthia togata* | Pink-barred Sallow | | catkins of willow and poplar - then on herbaceous plants | | + | | | | | | |
| *Xestia c-nigrum* | Setaceous Hebrew Character | | herbaceous plants | + | + | | | + | + | + | |
| *Xestia triangulum* | Double Square-spot | | deciduous trees and shrubs | | + | | | | | | |
| **Nolidae** | | | | | | | | | | | |
| *Nola cucullatella* | Short-cloaked Moth | | blackthorn and hawthorn | | | | | + | | | |
| **Notodontidae** | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | | | | | | | | | | |
| *Notodonta ziczac* | Pebble Prominent | | poplars and sallows/willows | | + | | | | | | |
| *Phalera bucephala* | Buff-tip | | deciduous trees | | + | | | | | | |
| *Ptilodon capucina* | Coxcomb Prominent | | deciduous trees | | + | | | | | | |
| **Oecophoridae** | | | | | | | | | | | |
| *Agonopterix heracliana* | | | umbellifers, especially cow parsley, hogweed and Angelica | + | | | | | | | |
| *Batia unitella* | | | under loose dead bark, feeding on fungi | + | | | | + | | | |
| *Carcina quercana* | The Flat Cooper | | deciduous trees and bushes | | + | | | | | | |
| **Pyralidae** | | | | | | | | | | | |
| *Acentria ephemerella* | | | submerged aquatic plants | | | | | | | + | |
| *Agriphila straminella* | | | grasses | + | + | | | + | + | + | |
| *Agriphila tristella* | | | grasses | + | + | | | + | + | + | |
| *Catoptria pinella* | | | grasses | + | + | | | + | + | + | |
| *Chrysoteuchia culmella* | | | grasses | + | + | | | + | + | + | |
| *Conobathra repandana* | | | oak - usually feeding high in the canopy | | + | | | | | | |
| *Crambus perlella* | | | grasses | + | | | | | | | |
| *Endotricha flammealis* | | | trees and herbaceous plants - then on leaf litter | | | | | + | + | | |
| *Eudonia mercurella* | | | mosses on trunks, walls etc | | + | | | | | | |
| *Eurrhypara hortulata* | | | nettles | | + | | | | | | |
| *Phlyctaenia coronata* | | | elder, Viburnum, lilac, privet | | + | | | | | | |
| *Phycita roborella* | | | oak | | | | | + | | | |
| *Pleuroptya ruralis* | | | nettles | + | + | | | | | + | |
| *Scoparia ambigualis* | | | thought to feed amongst mosses | + | | | | | | | |
| **Sphingidae** | | | | | | | | | | | |
| *Deilephila elpenor* | Elephant Hawk-moth | | rosebay willow-herb | | + | | | | | | |
| *Laothoe populi* | Poplar Hawk-moth | | poplars and sallows/willows | + | + | | | | | | |
| **Tischeriidae** | | | | | | | | | | | |
| *Tischeria ekebladella* | | | mines leaves of oak | + | | | | | + | | |
| **Tortricidae** | | | | | | | | | | | |
| *Acleris ferrugana* | | | oak | | | | | | + | | |
| *Acleris forsskaleana* | | | maple, sycamore | | + | | | | + | | |
| *Agapeta hamana* | | | thistles - in the roots | + | | | + | | | | |
| *Aleimma loeflingiana* | | | oak, occasionally hornbeam and maple/sycamore | | + | | | | | | |
| *Apotomis betuletana* | | | birch | + | | | | | | | |
| *Cydia pomonella* | | | fruits of rosaceous trees, especially apple | + | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | | | | | | | |
| *Cydia splendana* | | | oak | | + | | | | | | |
| *Endothenia gentianaeana* | | | teasels - in the seed heads | + | | | | | | | |
| *Epiblema scutulana* | | | thistles - in the root and lower stem | | | | | | | | + |
| *Epiblema uddmanniana* | | | Rubus spp., mainly brambles | + | + | | | + | + | + | + |
| *Epiphyas postvittana* | | | deciduous trees | + | + | | | + | + | + | |
| *Eucosma cana* | | | thistles and Centaurea nigra - in the flower head | + | | | | | | | |
| *Eudemis profundana* | | | oak | + | | | | | | | |
| *Hedya salicella* | | | Salix alba and other Salix species | | + | | | | | | |
| *Pandemis corylana* | | | deciduous trees and shrubs | + | + | | | + | + | + | |
| *Pandemis heparana* | | | deciduous trees and shrubs | + | + | | | + | + | + | |
| *Pseudargyrotoza conwagana* | | | ash and privet in the fruits and seeds | + | + | | | + | + | + | |
| *Rhopobota naevana* | | | trees and shrubs - especially ivy and blackthorn | | + | | | | | + | |
| *Spilonota ocellana* | | | trees, shrubs and herbaceous plants | + | + | | | + | + | | |
| *Tortrix viridana* | Green Oak Tortrix | | oak | + | | | | | + | | |
| *Zeiraphera isertana* | | | oak | | | | | | + | | |
| **Yponomeutidae** | | | | | | | | | | | |
| *Acrolepia autumnitella* | | | woody nightshade (bittersweet) and deadly nightshade | | + | | | | | | |
| *Argyresthia bonnetella* | | | caterpillar feeds in the shoots of hawthorn | | | | | | + | | |
| *Argyresthia brockeella* | | | birch and alder | + | | | | | | | |
| *Argyresthia goedartella* | | | birch and alder | + | | | | | | | |
| *Plutella xylostella* | | | primary immigrant from overseas; temporary resident on Cruciferae | + | + | + | + | + | + | + | + |
| *Prays fraxinella* | | | feeds in buds, shoots and leaves of ash trees | + | + | + | | + | + | + | + |
| *Scythropia crataegella* | | | hawthorn - sometimes blackthorn | | | | | | + | | |
| *Swammerdamia caesiella* | | | birch | + | | | | | | | |
| *Swammerdamia pyrella* | | | hawthorn, apple and pear are recorded | | + | | | | | | |
| *Ypsolopha parenthesella* | | | oak, hornbeam, birch, hazel and other trees | | | | | | + | | |
| *Ypsolopha scabrella* | | | apple and hawthorn | + | | | | | | | |
| *Ypsolopha sequella* | | | maple and sycamore | | + | | | | | | |
| **MECOPTERA** | **SCORPIONFLIES** | | | | | | | | | | |
| **Panorpidae** | | | | | | | | | | | |
| *Panorpa germanica* | | | edge habitats | | + | | + | | | | + |
| **MYRIAPODA: CHILOPODA** | **CENTIPEDES** | | | | | | | | | | |
| **Cryptopidae** | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | | | | | | | | | | | |
| *Cryptops hortensis* | | | amongst litter - often synanthropic | + | | | | | | | |
| **Lithobiidae** | | | | | | | | | | | |
| *Lithobius forficatus* | | | many habitats | + | | | | | | | |
| *Lithobius microps* | | | detritivorous | + | | | | | | | |
| **MYRIAPODA: DIPLOPODA** | **MILLIPEDES** | | | | | | | | | | |
| **Julidae** | | | | | | | | | | | |
| *Tachypodoiulus niger* | a snake millipede | | many habitats and often found climbing trees | | + | | | | | | |
| **NEUROPTERA** | **LACEWINGS** | | | | | | | | | | |
| **Chrysopidae** | **Green lacewings** | | | | | | | | | | |
| *Chrysopa perla* | | | aphid predator amongst herbage | + | + | | + | | | | + |
| *Chrysoperla carnea s.str.* | | | aphid predator of trees and bushes | + | + | + | + | + | + | + | + |
| *Cunctochrysa albolineata* | | | predatory on aphids in tree foliage | | + | | | | | + | |
| *Nineta flava* | | | thought to be associated with oak, feeding on aphids on the leaves | | | | | | + | | |
| **Coniopterygidae** | **Wax flies** | | | | | | | | | | |
| *Conwentzia psociformis* | | | arboreal on deciduous trees | | + | | | | | | |
| **Hemerobiidae** | **brown lacewinhs** | | | | | | | | | | |
| *Hemerobius humulinus* | | | trees and bushes, hedges, etc | | + | | | | | | |
| *Hemerobius lutescens* | | | trees and bushes, hedges, etc | + | + | | | | | | |
| *Hemerobius micans* | | | oak | | + | | | | + | | |
| *Micromus paganus* | | | ubiquitous, but usually in association with wood or scrub | | + | | | | | | + |
| *Wesmaelius subnebulosus* | | | larvae are aphid predators on trees and bushes | | + | + | | | | | + |
| **ORTHOPTERA** | | | | | | | | | | | |
| **Acrididae** | | | | | | | | | | | |
| *Chorthippus brunneus* | Field grasshopper | | grassland | + | | | + | | | | |
| **Tettigoniidae** | | | | | | | | | | | |
| *Leptophyes punctatissima* | Speckled Bush-cricket | | rough herbage and scrub | | + | | | | | | |
| *Meconema thalassinum* | Oak Bush-cricket | | oak trees, especially when at the woodland edge | | + | | | | | | |
| *Metrioptera roeselii* | Roesel's Bush-cricket | NS(Nb) | long grassland | | + | | + | | | | |
| *Pholidoptera griseoaptera* | Dark Bush-cricket | | scrub and edge habitats | | + | | | | | | |
| **PSOCOPTERA** | **BARK LICE** | | | | | | | | | | |
| **Ectopsocidae** | | | | | | | | | | | |
| *Ectopsocus petersi* | | | associated with trees and bushes | | + | | | | | | |
| **Stenopsocidae** | | | | | | | | | | | |

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| | | | | | | | | | | | |
| *Graphopsocus cruciatus* | | | associated with broad-leaved trees | | + | | | | | | |

## APPENDIX 2: INVERTEBRATE STATUS CODES

Earlier published reviews of scarce and threatened invertebrates employed the Red Data Book criteria used in the British Insect Red Data Book (Shirt 1987) with the addition of the category RDBK (Insufficiently Known) after in 1983. In addition, the status category Nationally Notable (now termed Nationally Scarce) was used from 1991. The original criteria of the International Union for the Conservation of Nature (IUCN – now called the World Conservation Union) for assigning threat status used in these publications had the categories *Endangered, Vulnerable,* and *Rare,* which were defined rather loosely and without quantitative parameters. The application of these categories was largely a matter of subjective judgment, and it was not easy to apply them consistently within a taxonomic group or to make comparisons between groups of different organisms. The deficiencies of the old system were recognised internationally, and in the mid-1980s proposals were made to replace it with a new approach which could be more objectively and consistently applied. In 1989, the lUCN's Species Survival Commission Steering Committee requested that a new set of criteria be developed to provide an objective framework for the classification of species according to their extinction risk. The first, provisional, outline of the new system was published in 1991. This was followed by a series of revisions, and the final version adopted as the global standard by the IUCN Council in December 1994. The guidelines were recommended for use also at the national level. In 1995, the Joint Nature Conservation Committee (JNCC) endorsed their use as the new national standard for Great Britain, and subsequent British Red Data Books have used these revised IUCN criteria. These criteria are used in this present report and are as follows:

**EXTINCT (EX)** A species is *Extinct* when there is no reasonable doubt that the last individual has died.

**EXTINCT IN THE WILD** A species is *Extinct* in the wild when it is known to survive only in cultivation, in captivity or as a naturalised population (or populations) well outside the past range.

**CRITICALLY ENDANGERED**
A species is *Critically Endangered* when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the following criteria:

**A. Population reduction in the form of either of the following:**

1. An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on direct observation, an index of abundance appropriate for the species, a decline in area of occupancy, extent of occurrence and/or quality of habitat, actual or potential levels of exploitation or the effects of introduced species, hybridisation, pathogens, pollutants, competitors or parasites.
2. A reduction of at least 80%, projected or suspected to be met within the 10 years or three generations, whichever is the longer, based any of these parameters.

**B. Extent of occurrence estimated to be less than 100 $Km^2$ or areas of occupancy estimated to be less than 10 $Km^2$ and estimates indicating any <u>two</u> of the following:**

1. Severely fragmented or known to exist at only a single location.
2. Continuing decline, observed, inferred or projected, in any of the following: a. extent of occurrence b. area of occupancy c. area, extent and/or quality of habitat d. number of locations or sub-populations e. number of mature individuals
3. Extreme fluctuations in extent of occurrence, area of occupancy, number of locations or sub-populations or number of mature individuals.

**C. Population estimated to number less than 250 mature individuals and either:**

1. An estimated continuing decline of at least 25% within 3 years or one generation, whichever is longer or
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either severely fragmented *(i.e.* no sub-population estimated to contain more than 50 mature individuals) or all individuals are in a single sub-population

**D. British population estimated to number less than 50 mature individuals.**

**E. Quantitative analysis showing the probability of extinction in the wild of at least 50% within 10 years or 3 generations, whichever is the longer.**

**ENDANGERED (Formerly RDB category 1)**

A species is Endangered when it is not *Critically Endangered* but is facing a very high risk of extinction in the wild in the near future, as defined by any of the following criteria:

**A. Population reduction in the form of either of the following:**

1. An observed, estimated, inferred or suspected reduction of at least 50% over the last 10 years or three generations, whichever is the longer, based on direct observation, an index of abundance appropriate for the species, a decline in area of occupancy, extent of occurrence and/or quality of habitat, actual or potential levels of exploitation or the effects of introduced species, hybridisation, pathogens, pollutants, competitors or parasites.
2. A reduction of at least 50%, projected or suspected to be met within the 10 years or three generations, whichever is the longer, based any of these parameters.

**B. Extent of occurrence estimated to be less than 5,000 $Km^2$ or areas of occupancy estimated to be less than 10 $Km^2$ and estimates indicating any <u>two</u> of the following:**

1. Severely fragmented or known to exist at no more than five locations.
2. Continuing decline, observed, inferred or projected, in extent of occurrence, area of occupancy, area, extent and/or quality of habitat, number of locations or sub-populations or the number of mature individuals.

**C. Population estimated to number less than 2500 mature individuals and either:**

1. An estimated continuing decline of at least 20% within 5 years or 2 generations, whichever is longer or
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either severely fragmented *(i.e.* no sub-population estimated to contain more than 250 mature individuals) or all individuals are in a single sub-population

**D. British population estimated to number less than 250 mature individuals.**

**E. Quantitative analysis showing the probability of extinction in the wild of at least 20% within 20 years or 5 generations, whichever is the longer.**.

**VULNERABLE (Formerly RDB category 2)**

A species is *Vulnerable* when it is not *Critically Endangered or Endangered but* is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the following criteria (A to E):

**A. Population reduction in the form of either of the following:**

1. An observed, estimated, inferred or suspected reduction of at least 20% over the last 10 years or three generations, whichever is the longer, based on direct observation, an index of abundance appropriate for the species, a decline in area of occupancy, extent of occurrence and/or quality of habitat, actual or potential levels of exploitation or the effects of introduced species, hybridisation, pathogens, pollutants, competitors or parasites.
2. A reduction of at least 20%, projected or suspected to be met within the 10 years or three generations, whichever is the longer, based any of these parameters.

**B. Extent of occurrence estimated to be less than 20,000 $Km^2$ or areas of occupancy estimated to be less than 20,000 $Km^2$ and estimates indicating any <u>two</u> of the following:**

1. Severely fragmented or known to exist at no more than ten locations. Continuing decline, observed, inferred or projected, in extent of occurrence, area of occupancy, area, extent and/or quality of habitat, number of locations or sub-populations or the number of mature individuals.
2. Extreme fluctuations in extent of occurrence, area of occupancy, number of locations or sub-populations or number of mature individuals.

**C. Population estimated to number less than 10,000 mature individuals and either:**

1. An estimated continuing decline of at least 10% within 10 years or 3 generations, whichever is longer or
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either severely fragmented *(i.e.* no sub-population estimated to contain more than 1000 mature individuals) or all individuals are in a single sub-population

**D. Population very small or restricted in the form of either of the following:**

1. Population estimated to number less than 1,000 mature individuals.
2. Population is characterised by an acute restriction in its area of occupancy (typically less than 100 km) or in the number of locations (typically less than 5). Such a species would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming *Critically Endangered* or even *Extinct* in a very short period.

**E. Quantitative analysis showing the probability of extinction in the wild of at least 10% within 100 years.**

**LOWER RISK (Formerly RDB category 3)**
A species is Lower Risk when it has been evaluated but does not satisfy the criteria for any of the categories *Critically Endangered, Endangered* or *Vulnerable.* Species included in the Lower Risk category can be separated into three sub-categories:

• **Conservation Dependent** species which are the focus of a continuing species -specific or habitat-specific conservation program targeted towards the species in question, the cessation of which would result in the species qualifying for one of the threatened categories above within a period of five years.

• **Near Threatened** Species which do not qualify for *Lower Risk (Conservation Dependent),* but which are close to qualifying for *Vulnerable.*

• **Least Concern**
Species which do not qualify for *Lower Risk (Conservation Dependent)* or *Lower Risk (Near Threatened).*

**DATA DEFICIENT** A species is *Data Deficient* when there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status. A species in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. *Data Deficient* is therefore not a category of threat or Lower Risk.

**LOWER RISK (NATIONALLY SCARCE – FORMERLY NATIONALLY NOTABLE)**
Species which are not included within the IUCN threat categories and are estimated to occur less than 100 hectads of the Ordnance Survey national grid in Great Britain. It should be noted that Lower Risk (Nationally Scarce) is not a threat category, but rather an estimate of the extent of distribution of these species. Lower Risk species are subdivided as follows:

**Na** species estimated to occur within the range of 16 to 30 10-kilometre squares of the National Grid System.

**Nb** species estimated to occur within the range 31 to 100 10-kilometre squares of the National Grid System.

**N** Diptera (flies) not separated, falling into either category Na or Nb.

**NATIONALLY LOCAL (L)**
Species which, whilst fairly common, are evidently less widespread than truly common species, but also not qualifying as Nationally Notable having been recorded from over one hundred, but less than three hundred, ten-kilometre squares of the UK National Grid.

**ASSOCIATED DEFINITIONS**

***Extent of occurrence***
Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a species, excluding cases of vagrancy. This measure may exclude discontinuities or disjunctions within the overall distributions of species (e.g. large areas of obviously unsuitable habitat) (but see 'area of occupancy'). Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence).

***Area of occupancy***
Area of occupancy is defined as the area within its 'extent of occurrence' (see definition) which is occupied by a species, excluding cases of vagrancy. The measure reflects the fact that a species will not usually occur throughout the area of its extent of occurrence, which may, for example, contain unsuitable habitats. The area of occupancy is the smallest area essential at any stage to the survival of existing populations of a species *(e.g.* colonial nesting sites, feeding sites for migratory species). The size of the area of occupancy will be a function of the scale at which it is measured, and should be at a scale appropriate to relevant biological aspects of the species. The criteria include values in $km^2$, and thus to avoid errors in classification, the area of occupancy should be measured on grid squares (or equivalents) which are sufficiently small.

# APPENDIX 3: AQUATIC INVERTEBRATE SPECIES RECORDED

| Group / species | English name | Ecological associations and comments | In aquatic area | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 |
| | | | | | | | | |
| **ANNELIDA** | **LEECHES** | | | | | | | |
| **Erpobdellidae** | | | | | | | | |
| *Erpobdella testacea* | | eutrophic water bodies where it feeds on insect larvae | | + | | | | |
| **COLEOPTERA** | **WATER BEETLES** | | | | | | | |
| **Dytiscidae** | | | | | | | | |
| *Agabus bipustulatus* | | freshwater ponds etc | | + | | | | |
| *Hydroporus palustris* | | freshwater ponds etc | | + | | | | |
| *Hydroporus planus* | | most water bodies will support this common species | | + | | | + | |
| *Hydroporus pubescens* | | freshwater ponds etc | | + | | | | |
| **Elmidae** | | | | | | | | |
| *Limnius volkmari* | | aquatic species | + | | | | + | |
| **Haliplidae** | | | | | | | | |
| *Haliplus ruficollis s. str.* | | ponds ditches and similar static water bodies | | + | | | + | |
| **Hydrophilidae** | | | | | | | | |
| *Helophorus minutus* | | | | + | | | | |
| **CRUSTACEA: AMPHIPODA** | | | | | | | | |
| **Gammaridae** | | | | | | | | |
| *Gammarus pulex* | | most freshwater habitats | | + | + | + | + | |
| **CRUSTACEA: ISOPODA** | | | | | | | | |
| **Asellidae** | | | | | | | | |
| *Asellus aquaticus* | freshwater hog louse | most freshwater habitats | | + | + | + | + | |
| **DIPTERA** | **TRUE FLIES** | | | | | | | |
| **Chironomidae** | **midges** | | | | | | | |
| unidentified larvae | | | | + | + | + | + | |
| **Culicidae** | **mosquitoes** | | | | | | | |
| unidentified larvae | | | | + | | | | |
| **Tipulidae** | **craneflies** | | | | | | | |
| unidentified larvae | | | | | | + | + | |
| **EPHEMEROPTERA** | **MAYFLIES** | | | | | | | |
| **Baetidae** | | | | | | | | |
| *Baetis rhodani* | | Usually in running water - especially riffles | + | | | | | |
| **HETEROPTERA** | **WATER BUGS** | | | | | | | |
| **Corixidae** | | | | | | | | |
| *Callicorixa praeusta* | | Aquatic species. Most still or slow-flowing water bodies. | | + | | | + | |
| *Sigara lateralis* | | freshwater ponds etc thriving in those polluted by animal dung | | + | | | | |
| *Sigara stagnalis* | | Aquatic species. | | + | | | | |
| **Gerridae** | | | | | | | | |
| *Gerris lacustris* | | Aquatic species. Ponds, lakes and canals with abundant submerged vegetation. | | + | | | | |
| **Naucoridae** | | | | | | | | |
| *Ilyocoris cimicoides* | | Aquatic species - weedy ponds, canals etc | | + | | + | | |
| **Notonectidae** | | | | | | | | |
| *Notonecta glauca* | | Aquatic species - weedy ponds, canals etc | | + | | | | |
| **MOLLUSCA** | **WATER SNAILS** | | | | | | | |
| **Lymnaeidae** | | | | | | | | |
| *Lymnaea peregra* | the wandering snail | ponds, streams and marshes | | + | + | + | + | |
| *Planorbis planorbis* | | freshwater habitat with pondweeds | | + | | | | |
| **ODONATA** | | | | | | | | |
| **Coenagriidae** | | | | | | | | |
| *Enallagma cyathigerum* | Common blue | static, open water bodies with emergent vegetation, | | + | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | damselfly | flying mid May to early October | | | | | | |
| *Ischnura elegans* | Blue-tailed damselfly | found in most permanent water bodies, the adults flying from May to August | | + | | | | |
| **PLECOPTERA** | **STONEFLIES** | | | | | | | |
| **Nemouridae** | | | | | | | | |
| *Nemoura cinerea* | | aquatic larvae are associated with still and very slow water | | + | | | | |
| **TRICHOPTERA** | **CADDIS FLIES** | | | | | | | |
| **Limnephilidae** | | | | | | | | |
| *Limnephilus auricula* | | common species of grassy pools and ditches including temporary waters | + | | | | | |

# Appendix 6G Great Crested Newts

| Pond Number | Description | HSI | Presence of great crested newts confirmed |
|---|---|---|---|
| 1 | Field waterbody immediately north of Bainton Road in Bucknell. The waterbody had almost entirely dried out by the end of the survey. To the south an intact hedgerow to the north an arable field. Waterbody covered by grass with no areas of open water. This waterbody is sub-optimal for great crested newts. | 0.6 (average) | No, smooth newt (*Lissotriton vulgaris*) present. |
| 2 | A large, old landscaped waterbody lined by limestone walls mostly collapsed or covered by vegetation. The northern banks were natural with marginal and emergent vegetation. The eastern and western banks were shaded by woodland. A small causeway provided access to a man-made island. | 0.69 (average) | Yes, smooth newt also present. |
| 3 | On line pond linked to the winterbourne. Shallow waterbody dry by late June. A relict hedgerow on the southern boundary. Waterbody supports Water Mint (*Mentha aquatica*) and Fool's Water-cress (*Apium nodiflorum*). Sub-optimal for great created newts since dries out too early in the year. | 0.47 (poor) | No, common frog (*Rana temporaria*) present. |
| 4 | On line pond linked to the winterbourne. Shallow waterbody dry by late June. Hedgerows on two sides. Waterbody covered by Bittersweet (*Solanum dulcamara*), Brookline (*Veronica beccabunga*) and Great Willowherb (*Epilobium hirsutum*). Sub-optimal for great created newts since dries out too early in the year. | 0.53 (below average) | No; no other amphibians recorded. |
| 5 | Large waterbody in the village green. Set in an area of mown grass. To the west was a band of mature trees and scrub; to the east the Bicester Road. This waterbody has large areas suitable for display and marginal vegetation suitable for egg-laying. This waterbody dries out in early summer. | 0.54 (below average) | Yes, smooth newt and common frog also present. |
| 6 | Crowmarsh pond spring fed and stream fed. It supported a diverse wetland flora (see Ponds in the main body of the report). This waterbody has large areas suitable for display and marginal vegetation suitable for egg-laying. This pond supports large numbers of three-spined stickleback (*Gastreosteus aculeatus*) and it therefore sub-optimal for use by great crested newts. | 0.43 (poor) | No, smooth newt present. |
| 7 | Waterbody heavily poached by cattle with a diverse marginal flora that included Pink Water-speedwell (*Veronica catenata*) and Common Water-crowfoot (*Ranunculus aquatilis*). This waterbody has areas suitable for display and marginal vegetation suitable for egg-laying. | 0.75 (good) | Yes, smooth newt and common frog also present. |

| Pond Number | Description | HSI | Presence of great crested newts confirmed |
|---|---|---|---|
| 8 | Very shallow spring-fed waterbody, water levels barely 10mm deep. Ephemeral waterbody considered sub-optimal for great crested newts. | 0.49 (poor) | No; no other amphibians recorded. |
| 9 | Disused swimming pool with Ivy (*Hedera helix*) covered walls and Duckweed (*Lemna* spp.) covered water surface. | 0.64 (average) | Yes, smooth newt also present. |
| 10 | Pond NW of Hawkwell Farm. Water surface covered by water-crowfoot (*Ranunculus* sp.). Waterbody suitable for use by great crested newts but not close to any ponds where their presence has been confirmed. | 0.45 (poor) | No, smooth newt present. |
| 11 | Waterbody between an access track and hedgerow, it supported a diverse marginal flora with few aquatic plants. It appeared to dry out on a regular basis making it sub-optimal for use by great crested newts. | Unsuitable dry by late May | No; no other amphibians recorded. |
| 12 | Large man-made waterbody grazed by Canada geese (*Brenta canadenis*). Bogbean (*Menyanthes trifoliata*) and Water Mint were recorded on the water edge. Fish were also recorded within this feature (identification obscured by the turbidity of the water) making it sub-optimal for use by great crested newts. | 0.37 (poor) | No; no other amphibians recorded. |
| 13 | Pond online with a winterbourne. This pond was used by domestic ducks and devoid of wetland vegetation. It was sub-optimal for use by great crested newts. | 0.39 (poor) | No, smooth newt present. |
| 14 | Pond located within an arable field and was approximately 20m long and 15m wide. It was almost completely covered in the aquatic plant Common Water-crowfoot (*Ranunculus aquatilis*). Marginal vegetation comprised Branched Bur-reed (*Sparganium erectum*), Water Mint (*Mentha aquatica*) and Redshank (*Persicaria maculosa*), grading into False Oat-grass (*Arrhenatherum elatius*) and Common Nettle (*Urtica dioica*) in the drier areas around the pond. Whilst not connected to the hedgerow network directly, the pond was located approximately 60m from hedgerows that bound the arable field. Tall ruderal habitat and wood piles were located close to the farm building approximately 150m away, connected to the hedgerows that bound the arable field. These features comprise suitable terrestrial habitat for great crested newts. | 0.79 (good) | Yes, smooth newt also present. |

| Pond Number | Description | HSI | Presence of great crested newts confirmed |
|---|---|---|---|
| 15 | Pond located on the boundary of a grazed field, bounded on its southern side by a steep bank vegetated with tall ruderal herbs and grass, which links to the hedgerow bounding the southern edge of the field. The pond was approximately 40m long and 20m wide with a small island in the centre. Aquatic and marginal vegetation comprised Water Mint, Soft-rush (*Juncus effusus*), Bulrush (*Typha latifolia*), Toad Rush (*Juncus bufonius* sens. str.) and Hard Rush (*Juncus inflexus*). Patches of willow (Salix sp.) and Bramble (*Rubus fruticosus* agg.) scrub bordered the pond, becoming dense in the south western corner. | 0.76 (good) | Yes, smooth newt also present. |

The maximum adult great crested newt count gained for Pond 14 was 15 on the 17th May. The maximum adult great crested newt count gained for Pond 15 was 2 on the 13th and 26th May. These results indicate the presence of a population at the lower end of the medium size class at Pond 14 and a small population size class at Pond 15. In addition, small numbers of smooth newts were found in both ponds.

# Appendix 6H Breeding Birds

Birds recorded during the breeding bird surveys in 2010 and/or 2011. Not all species that were recorded were breeding within the Masterplan site. For the complete BOCC Red and Amber lists see Easton et al (Ref 6-23).

| **Species** | | **Conservation Value** | **Year** |
|---|---|---|---|
| Sparrowhawk | Accipter nisus | - | 2010 |
| Long-tailed tit | Aegithalos caudatus | - | 2011 |
| Skylark | Alauda arvensis | BOCC Red list<br>Section 41 NERC Act | 2010, 2011 |
| Red-legged partridge | Alectoris rufa | - | 2010 |
| Mallard | Anas platyrhynchos | BOCC Amber list | 2011 |
| Little owl | Athene noctua | - | 2010 |
| Canada goose | Branta canadensis | - | 2010, 2011 |
| Buzzard | Buteo buteo | - | 2010, 2011 |
| Linnet | Carduelis cannabina | BOCC Red list<br>Section 41 NERC Act | 2010, 2011 |
| Goldfinch | Carduelis carduelis | - | 2010, 2011 |
| Greenfinch | Carduelis chloris | - | 2010, 2011 |
| Stock dove | Columba oenas | BOCC Amber list | 2010, 2011 |
| Wood pigeon | Columba palumbus | - | 2010, 2011 |
| Carrion crow | Corvus corone | - | 2010, 2011 |
| Rook | Corvus frugilegus | - | 2011 |
| Jackdaw | Corvus monedula | - | 2010, 2011 |
| Cuckoo | Cuculus canorus | BOCC Red list<br>Section 41 NERC Act | 2010 |
| Blue tit | Cyanistes caeruleus | - | 2010, 2011 |
| Greater spotted woodpecker | Dendrocopos major | - | 2010 |
| Yellowhammer | Emberiza citrinella | BOCC Red list<br>Section 41 NERC Act | 2010, 2011 |
| Reed bunting | Emberiza schoeniclus | BOCC Amber list<br>Section 41 NERC Act | 2010 |
| Robin | Erithacus rubecula | - | 2010, |

| Species | | Conservation Value | Year |
|---|---|---|---|
| | | | 2011 |
| Kestrel | Falco tinnunculus | BOCC Amber list | 2010 |
| Chaffinch | Fringilla coelebs | - | 2010, 2011 |
| Coot | Fulica atra | - | 2010 |
| Moorhen | Gallinula chloropus | - | 2010, 2011 |
| Jay | Garrulus glandarius | - | 2010, 2011 |
| Swallow | Hirundo rustica | BOCC Amber list | 2010, 2011 |
| Herring gull | Larus argentatus | BOCC Red list<br>Section 41 NERC Act | 2011 |
| Pied wagtail | Motacilla alba | - | 2010, 2011 |
| Yellow wagtail | Motacilla flava flavissima | BOCC Red list<br>Section 41 NERC Act | 2010 |
| Spotted flycatcher | Muscicapa striata | BOCC Red list<br>Section 41 NERC Act | 2010 |
| Wheatear | Oenanthe oenanthe | BOCC Amber list | 2011 |
| Great tit | Parus major | - | 2010, 2011 |
| Marsh tit | Poecile palustris subsp. palustris/dresseri | BOCC Red list<br>Section 41 NERC Act | 2010 |
| House sparrow | Passer domesticus | BOCC Red list<br>Section 41 NERC Act | 2010 |
| Pheasant | Phasianus colchicus | - | 2010, 2011 |
| Chiffchaff | Phylloscopus collybita | - | 2010,<br>2011 |
| Willow warbler | Phylloscopus trochilus | BOCC Amber list | 2010, 2011 |
| Magpie | Pica pica | - | 2010, 2011 |
| Green woodpecker | Picus viridis | BOCC Amber list | 2010, 2011 |
| Dunnock | Prunella modularis | BOCC Amber list<br>Section 41 NERC Act | 2010, 2011 |
| Bullfinch | Pyrrhula pyrrhula | BOCC Amber list<br>Section 41 NERC Act | 2010, 2011 |
| Goldcrest | Regulus regulus | - | 2010, 2011 |
| Collard dove | Streptopelia decaocto | - | 2010 |
| Tawny owl | Strix aluco | - | 2010 |

| Species | | Conservation Value | Year |
|---|---|---|---|
| Starling | Sturnus vulgaris | BOCC Red list<br>Section 41 NERC Act | 2010, 2011 |
| Blackcap | Sylvia atricapilla | - | 2011 |
| Garden warbler | Sylvia borin | - | 2011 |
| Whitethroat | Sylvia communis | BOCC Amber list | 2010, 2011 |
| Lesser whitethroat | Sylvia curruca | - | 2010 |
| Wren | Troglodytes troglodytes | - | 2010, 2011 |
| Blackbird | Turdus merula | - | 2010, 2011 |
| Song thrush | Turdus philomelos | BOCC Red list<br>Section 41 NERC Act | 2010, 2011 |
| Mistle thrush | Turdus viscivorus | BOCC Amber list | 2010 |
| Barn owl | Tyto alba | BOCC Amber list<br>Schedule 1 Wildlife and Countryside Act | 2010 |
| Lapwing | Vanellus vanellus | BOCC Red list<br>Section 41 NERC Act | 2010 |

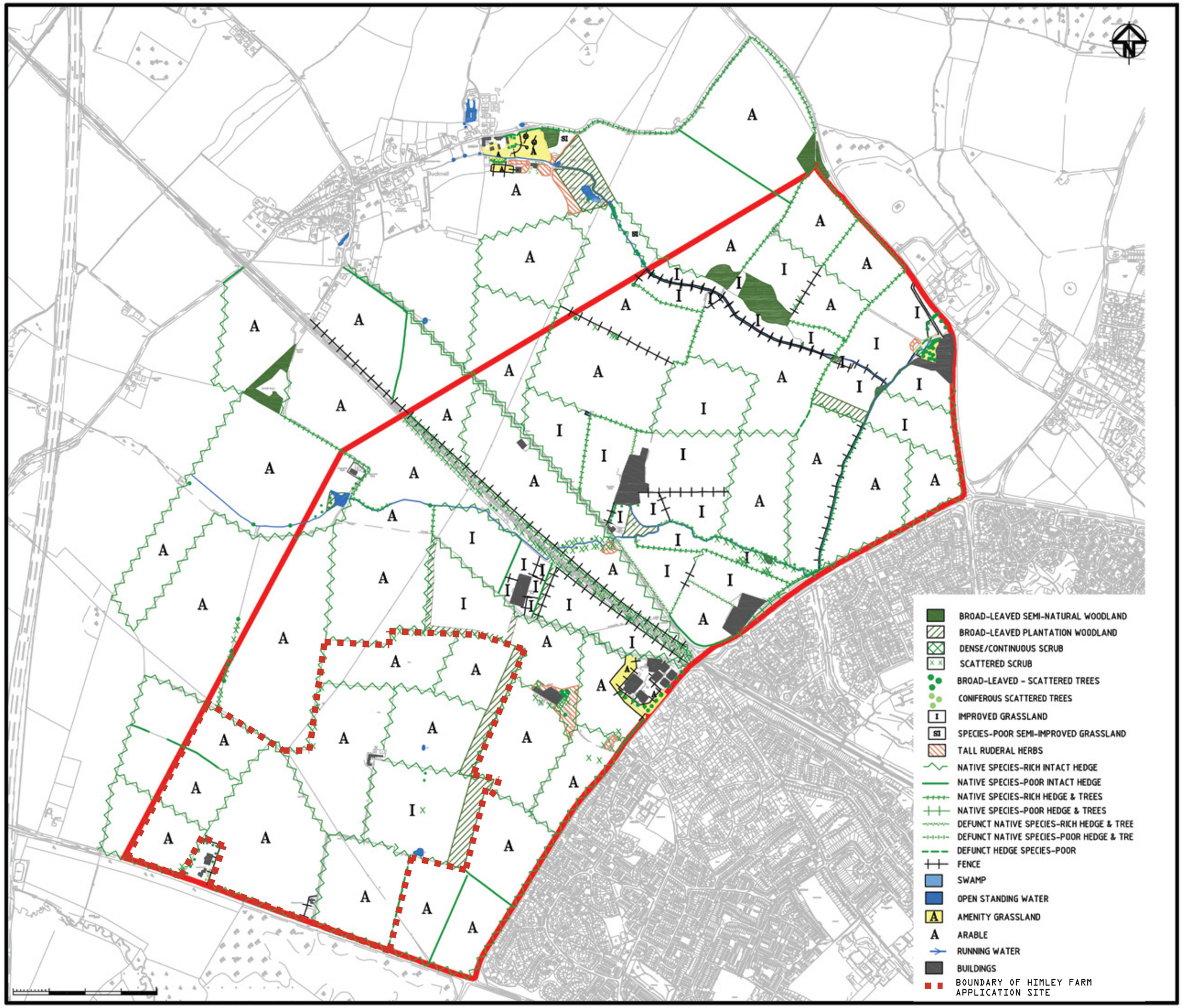
# Appendix 6I Wintering Birds

Birds recorded during the wintering bird surveys in 2010 and 2011. For the complete BOCC Red and Amber lists see Easton et al (Ref 6-23).

| **Species** | | **Conservation Value** |
|---|---|---|
| Long-tailed tit | Aegithalos caudatus | - |
| Skylark | Alauda arvensis | BOCC Red list<br>Section 41 NERC Act |
| Red-legged partridge | Alectoris rufa | - |
| Teal | Anas crecca | - |
| Mallard | Anas platyrhynchos | BOCC Amber list |
| Grey heron | Ardea cinerea | - |
| Little owl | Athene noctua | - |
| Buzzard | Buteo buteo | - |
| Linnet | Carduelis cannabina | BOCC Red list<br>Section 41 NERC Act |
| Goldfinch | Carduelis carduelis | - |
| Greenfinch | Carduelis chloris | - |
| Feral pigeon | Columba livia | - |
| Wood pigeon | Columba palumbus | - |
| Carrion crow | Corvus corone | - |
| Rook | Corvus frugilegus | - |
| Jackdaw | Corvus monedula | - |
| Blue tit | Cyanistes caeruleus | - |
| Greater spotted woodpecker | Dendrocopos major | - |
| Yellowhammer | Emberiza citrinella | BOCC Red list<br>Section 41 NERC Act |
| Reed bunting | Emberiza schoeniclus | BOCC Amber list<br>Section 41 NERC Act |
| Robin | Erithacus rubecula | - |
| Kestrel | Falco tinnunculus | BOCC Amber list |
| Chaffinch | Fringilla coelebs | - |
| Moorhen | Gallinula chloropus | - |
| Jay | Garrulus glandarius | - |
| Herring gull | Larus argentatus | BOCC Red list<br>Section 41 NERC Act |
| Lesser black-backed gull | Larus fuscus | - |
| Great black-backed gull | Larus marinus | - |
| Red kite | Milvus milvus | Schedule 1 Wildlife and Countryside Act |
| Pied wagtail | Motacilla alba | - |
| Blue tit | Parus caeruleus | - |
| Great tit | Parus major | - |
| Marsh tit | Poecile palustris subsp. palustris/dresseri | BOCC Red list<br>Section 41 NERC Act |
| House sparrow | Passer domesticus | BOCC Red list<br>Section 41 NERC Act |
| Grey partridge | Perdix perdix | BOCC Red list<br>Section 41 NERC Act |
| Pheasant | Phasianus colchicus | - |
| Magpie | Pica pica | - |
| Green woodpecker | Picus viridis | BOCC Amber list |
| Dunnock | Prunella modularis | BOCC Amber list<br>Section 41 NERC Act |
| Bullfinch | Pyrrhula pyrrhula | BOCC Amber list |

| Species | | Conservation Value |
|---|---|---|
| | | Section 41 NERC Act |
| Goldcrest | Regulus regulus | - |
| Woodcock | Scolopax rusticola | - |
| Collard dove | Streptopelia decaocto | - |
| Starling | Sturnus vulgaris | BOCC Red list<br>Section 41 NERC |
| Wren | Troglodytes troglodytes | - |
| Redwing | Turdus iliacus | BOCC Red list<br>Schedule 1 Wildlife and Countryside Act |
| Blackbird | Turdus merula | - |
| Fieldfare | Turdus pilaris | BOCC Red list<br>Schedule 1 Wildlife and Countryside Act |
| Song thrush | Turdus philomelos | BOCC Red list<br>Section 41 NERC Act |
| Mistle thrush | Turdus viscivorus | BOCC Amber list |
| Lapwing | Vanellus vanellus | BOCC Red list<br>Section 41 NERC Act |

# APPENDIX 7.3:
# HABITAT MAP OF THE NW BICESTER ECO TOWN AREA


BROAD-LEAVED SEMI-NATURAL WOODLAND
BROAD-LEAVED PLANTATION WOODLAND
DENSE/CONTINUOUS SCRUB
SCATTERED SCRUB
BROAD-LEAVED - SCATTERED TREES
CONIFEROUS SCATTERED TREES
IMPROVED GRASSLAND
SPECIES-POOR SEMI-IMPROVED GRASSLAND
TALL RUDERAL HERBS
NATIVE SPECIES-RICH INTACT HEDGE
NATIVE SPECIES-POOR INTACT HEDGE
NATIVE SPECIES-RICH HEDGE & TREES
NATIVE SPECIES-POOR HEDGE & TREES
DEFUNCT NATIVE SPECIES-RICH HEDGE & TREE
DEFUNCT NATIVE SPECIES-POOR HEDGE & TRE
DEFUNCT HEDGE SPECIES-POOR
FENCE
SWAMP
OPEN STANDING WATER
AMENITY GRASSLAND
ARABLE
RUNNING WATER
BUILDINGS
BOUNDARY OF HIMLEY FARM APPLICATION SITE

# APPENDIX 9.1:
# AIR QUALITY MODELLING STUDY

# Appendix 9.1: Air Quality Modelling Study

1.1 This Appendix presents the technical information and data upon which the air quality assessment is based.

## Model

1.2 In urban areas, pollutant concentrations are primarily determined by the balance between pollutant emissions that increase concentrations, and the ability of the atmosphere to reduce and remove pollutants by dispersion, advection, reaction and deposition. An atmospheric dispersion model is used as a practical way to simulate these complex processes; which requires a range of input data, which can include pollutant emissions rates, meteorological data and local topographical information.

1.3 The effect of the Development on local air quality was assessed using the advanced atmospheric dispersion model ADMS-Roads, taking into account the contribution of emissions from forecast road-traffic on the local road network and from the heating plant by the completion year.

1.4 The ADMS-Roads model is a comprehensive tool for investigating air pollution in relation to road networks, and can also take into account point sources such as emissions from heating plants. On review of the Site, and its surroundings, ADMS-Roads was considered appropriate for the assessment of the long and short term effects of the proposals on air quality. The model uses advanced algorithms for the height-dependence of wind speed, turbulence and stability to produce improved predictions of air pollutant concentrations. It can predict long-term and short-term concentrations, including percentile concentrations. The use of the ADMS-Roads model was agreed with the air quality Environment Health Officer (EHO) at Cherwell District Council (CDC).

1.5 ADMS-Roads model is a formally validated model, developed in the United Kingdom (UK) by CERC (Cambridge Environmental Research Consultants). This includes comparisons with data from the UK's air quality Automatic Urban and Rural Network (AURN) and specific verification exercises using standard field, laboratory and numerical data sets. CERC is also involved in European programmes on model harmonisation, and their models were compared favourably against other EU and U.S. EPA systems. Further information in relation to this is available from the CERC web site at www.cerc.co.uk.

## Model Scenarios

1.6 In order to assess the effect of the Development on local air quality, future 'without Development' and 'with Development' scenarios were assessed. The Development is anticipated to be complete in 2031 and therefore this is the year in which these future without and with development scenarios were modelled. The cumulative North West Bicester development is anticipated to be complete in 2046 and therefore this is the year in which the cumulative assessment has been modelled. The year 2013 was modelled to establish the existing baseline situation because it is the year for which available monitoring data surrounding the Site is available against which the air quality model is verified (discussed further below). Base year traffic data for 2012 and meteorological data for 2013 were also used to be consistent with the verification year.

1.7 Taking into account recent analyses by Defra[1] showing that historical $NO_x$ and $NO_2$ concentrations are not declining in line with emission forecasts, as outlined in main chapter, a sensitivity analysis has been undertaken on the basis of no future reductions in $NO_x/NO_2$ concentrations (i.e. considering the potential effects of the Development against the current

baseline 2013 conditions by applying the 2031 road traffic data to 2013 background concentrations and road traffic emission rates). The results for this sensitivity analysis are presented further below.

## Traffic Data

1.8 Traffic flow data comprising Annual Average Daily Traffic (AADT) flows, traffic composition (% HDVs – Heavy-Duty Vehicles) and speeds (kph) were used in the model as provided by Alan Baxter & Associates LLP for the surrounding road network. Table A1.1 presents the traffic data used within the air quality assessment. Baseline traffic data was supplied for 2012, however following consultation with Alan Baxter & Associates it was confirmed that there would not be a significant change in flows between 2012 and 2013 and therefore the 2012 flows have been used in the model assessment year of 2013 to be consistent with the most recent monitoring data available from CDC.

### Vehicle Speeds

1.9 To take into account the presence of slow moving traffic near junctions and at roundabouts, the speed on each road was reduced using the following criteria recommended within LAQM.TG(09)[2]:

- For a busy junction, an average of 20kph (approximately 12mph) was applied; and
- For other junctions (non-motorway) and roundabouts, where some slowing of traffic occurs, the speed was reduced by 10kph compared to the speed limit.

### Diurnal Profile

1.10 The ADMS-Roads model uses an hourly traffic flow based on the daily (AADT) flows. Traffic flows follow a diurnal variation throughout the day and week. Therefore, a diurnal profile was used in the model to replicate how the average hourly traffic flow would vary throughout the day and the week. This was based on data collated by Waterman from the Department for Transport (DfT) statistics Table *TRA0307: Traffic distribution by time of day on all roads in Great Britain, 2012*[3]. Figure A1.1 presents the diurnal variation in traffic flows that has been used within the model.

Figure A1.1: Diurnal Traffic Variation

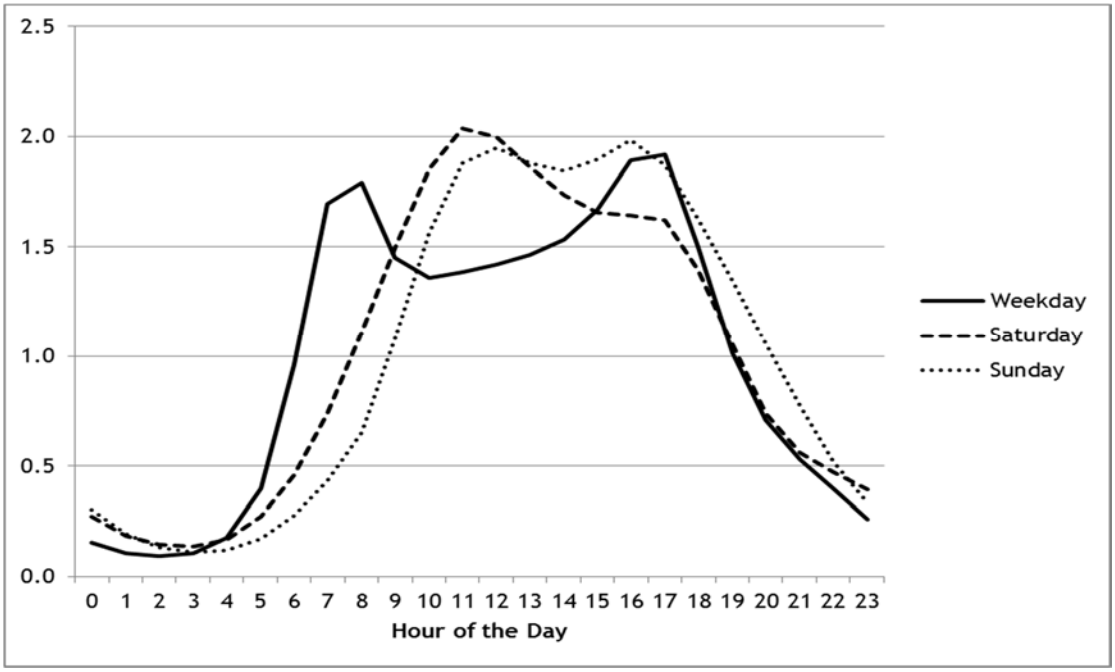


Table A1.1: 24 hour AADT Data Used within the Assessment

| Link Name | %HDV | Base 2013 | Without 2031 | With 2031 | 2046 Base | 2046 With Cumulative Schemes |
|---|---|---|---|---|---|---|
| A41 northbound, N of M40 J9 | 6.8 | 13,077 | 14,925 | 14,918 | 14,925 | 17,097 |
| A41 southbound, N of M40 J9 | 6.8 | 11,195 | 12,148 | 12,202 | 12,148 | 13,976 |
| A41 Oxford Rd, S of A41 junction | 6.8 | 24,442 | 40,349 | 41,196 | 40,349 | 47,087 |
| Vendee Drive, W of A41 junction | 6.8 | 2,912 | 8,447 | 8,822 | 8,447 | 10,055 |
| A41, N of Pingle Drive | 6.8 | 15,356 | 21,597 | 22,212 | 21,597 | 25,365 |
| Middleton Stoney Rd, W of Kings End | 6.8 | 8,786 | 10,276 | 10,604 | 10,276 | 12,104 |
| Middleton Stoney Rd, W of Howes Lane | 6.8 | 5,859 | 5,617 | 8,134 | 5,617 | 8,954 |
| Howes Lane, N of Middleton Stoney Rd | 6.8 | 6,362 | 10,997 | 10,402 | 10,997 | 12,008 |
| Howes Lane, E of Shakespeare Drive | 6.8 | 7,731 | 10,886 | 11,113 | 10,886 | 12,703 |
| Lords Lane, E of Bucknell Road | 6.8 | 10,261 | 13,546 | 12,965 | 13,546 | 14,943 |
| Lords Lane, W of Banbury Road | 6.8 | 11,239 | 13,701 | 12,942 | 13,701 | 14,942 |
| Bucknell Road, N of Lords Lane | 6.8 | 2,124 | 3,333 | 2,810 | 3,333 | 3,296 |
| Bucknell Road, S of Lords Lane | 6.8 | 6,643 | 7,005 | 7,372 | 7,005 | 8,395 |
| Banbury Road, N of Lords Lane | 6.8 | 11,142 | 15,854 | 16,688 | 15,854 | 19,003 |
| A4095 E of Banbury Road | 6.8 | 18,244 | 20,653 | 20,858 | 20,653 | 23,873 |
| Banbury Road, S of A4095 | 6.8 | 5,278 | 8,191 | 8,975 | 8,191 | 10,170 |
| Buckingham Road, S of Skimmingdish Lane | 6.8 | 7,542 | 12,143 | 13,021 | 12,143 | 14,794 |
| Queens Avenue, S of Bucknell Road | 6.8 | 12,042 | 19,870 | 20,407 | 19,870 | 23,308 |
| A41 E of A41 Oxford Road | 6.8 | 21,258 | 33,634 | 34,336 | 33,634 | 39,246 |
| A4421 Neunkirchen Way | 6.8 | 14,664 | 18,322 | 18,811 | 18,322 | 21,486 |
| A41, E of London Road roundabout | 6.8 | 22,685 | 17,422 | 17,591 | 17,422 | 20,134 |
| A4421, E of Skimmingdish Lane | 6.8 | 15,283 | 22,289 | 22,928 | 22,289 | 26,182 |
| Shakespeare Drive, S of Howes Lane | 6.8 | 1,422 | 1,079 | 1,435 | 1,079 | 1,593 |
| M40 J10 northbound off slip road | 14.5 | 5,230 | 6,202 | 6,824 | 6,202 | 7,730 |
| Ardley Road (E of B430) | 6.8 | 1,945 | 4,335 | 4,528 | 4,335 | 5,160 |
| M40 J10 southbound on slip road (from A43) | 14.5 | 4,896 | 3,895 | 3,927 | 3,895 | 4,496 |
| B430 M40 over bridge | 6.8 | 21,065 | 23,972 | 24,271 | 23,972 | 27,771 |
| A4095 N of Chesterton | 6.8 | 5,588 | 9,928 | 10,177 | 9,928 | 11,626 |
| Shakespeare Drive, E of Middleton Stoney Road | 6.8 | 5,157 | 8,820 | 9,537 | 8,820 | 10,824 |
| The Approach, W of Bucknell Road | 6.8 | 2,724 | 4,393 | 5,191 | 4,393 | 5,832 |
| A41 East of Pioneer Road | 6.8 | 21,863 | 29,434 | 29,530 | 29,434 | 33,827 |
| Bicester Road, E of A4421 junction | 6.8 | 6,193 | 4,843 | 4,837 | 4,843 | 5,544 |
| A4421 N of Skimmingdish Lane | 6.8 | 11,819 | 16,551 | 16,831 | 16,551 | 19,247 |
| Fringford Road, N of Caversfield | 6.8 | 900 | 1,389 | 1,402 | 1,389 | 1,605 |
| B4100 Banbury Road, N of Bainton Road | 6.8 | 11,142 | 14,282 | 14,501 | 14,282 | 16,586 |
| Ardley Road, N of Bucknell | 6.8 | 1,945 | 4,267 | 4,478 | 4,267 | 5,101 |
| Middleton Road, W of Bucknell | 6.8 | 189 | 300 | 1,267 | 300 | 1,311 |
| B4030 Middleton Stoney Road, NW of NWB | 6.8 | 5,859 | 5,631 | 6,458 | 5,631 | 7,280 |
| Green Lane, W of Chesterton | 6.8 | 3,711 | 5,670 | 5,751 | 5,670 | 6,579 |
| Wendlebury Road, E of M40 | 6.8 | 2,603 | 3,406 | 3,486 | 3,406 | 3,983 |
| M40 | 14.5 | 62,048 | 73,113 | 73,113 | 73,113 | 73,113 |

## Street Canyon Effect

1.11 Narrow streets with tall buildings on either side have the potential to create a confined space, which can interfere with the dispersion of traffic pollutants and may result in pollutant emissions accumulating in these streets. In an air quality model these narrow streets are described as street canyons.

1.12 ADMS-Roads includes a street canyon model to take account of the additional turbulent flow patterns occurring inside such a narrow street with relatively tall buildings on both sides. LAQM.TG(09) identifies a street canyon *"as narrow streets where the height of buildings on both sides of the road is greater than the road width."*

1.13 Following a review of the road network to be included within the model, it was considered that modelled roads are relatively wide and the majority of existing buildings along these roads are not considered to be tall. The proposed buildings within the Site would not cause any new canyons to be created. Therefore, no street canyons were included within the model for any of the scenarios considered.

## Heating Plant

1.14 The proposed heating plant would comprise a combination of boilers; assumed for this assessment to comprise one gas-fired Combined Heat and Power (CHP) plant, four gas-fired boilers and a biomass boiler which would release emissions through flues at the top of proposed Energy Centre building. The stack parameters used within the ADMS-Roads model for the gas-fired CHP and boilers and biomass boiler, are presented in Table A1.2 below. A stack height of 20m is now proposed. However, a stack height of 16m was modelled. This is considered to represent a worst case scenario.

Table A1.2: Stack Parameters for the Heating Plant

| Unit | Number | Grid Reference | Flue Diameter (m) | Release Rate (m/s) | Release Height (m) | Release Temperature (deg °C) | Total Emissions (g/s) |
|---|---|---|---|---|---|---|---|
| 200kW Boiler | 1 | 456054, 222956 | 0.35 | 6 | 16 | 101 | NOx: 0.004 |
| 1000kW Boiler | 2 | | 0.35 | 6 | 16 | 101 | NOx: 0.044 |
| 2000kW Boiler | 1 | | 0.45 | 6 | 16 | 93 | NOx: 0.044 |
| 550kW Biomass Boiler | 1 | | 0.4 | 6 | 16 | 190 | NOx: 0.0011<br>$PM_{10}$: 0.0004 |
| 2MW CHP | 1 | | 0.4 | 27.5 | 16 | 120 | NOx: 0.36 |

Note: For gas-fired plants emission factors are not provided for $PM_{10}$ because gas-fired plants do not emit any significant level of particulates therefore $PM_{10}$ emission factors are only provided for the biomass boiler

## Road Traffic Emission Factors

1.15 ADMS-Roads version 3.2 SP1 (September 2014) has been used. This includes a number of UK emission factor datasets. The UK Emission Factor Toolkit (EFT) version 6.0.1 published July 2014 and included with the ADMS-Roads model has been used in the assessment.

1.16 The EFT uses traffic flow, %HDV, speed and road type information as input data and calculates outputs as total emissions as g/km and g/km/s for the selected pollutant(s).

1.17 2030 is the latest forecast year available for road traffic emissions. It is assumed that the 2031 and 2046 road traffic emissions will remain at 2030 levels.

## Background Pollutant Concentrations

1.18 The ADMS-Roads model requires background pollutant concentration data (i.e. concentrations due to the contribution of pollution sources not directly taken into account in the dispersion modelling), that correspond to the year of assessment, which is added to contributions from the modelled pollution sources.

1.19 Background monitoring is undertaken by CDC using two diffusion tubes, located at Villiers Road approximately 2.0km south east of the Site and at Tarnarisk Gardens approximately 2.7km northeast. Table A1.3 shows the annual mean $NO_2$ concentrations measured at these locations.

Table A1.3: Annual Mean $NO_2$ Concentrations at the CDC Urban Background Diffusion Tubes ($\mu g/m^3$)

| Pollutant | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|
| Villiers Road | 26.8 | 19.0 | 20.5 | 19.8 |
| Tarnarisk Gardens | 22.3 | 22.3 | 17.6 | 17.4 |

Source: CDC Progress Report 2014

1.20 Table A1.3 shows that at the annual mean $NO_2$ concentrations are below the annual mean objective of $40\mu g/m^3$ at both diffusion tube locations between 2010 and 2013.

1.21 In addition to the urban background monitoring at the two diffusion tube locations, background concentrations of $NO_x$, $NO_2$, $PM_{10}$ and $PM_{2.5}$ are available from the Defra Air Quality Archive for 1x1km grid squares for assessment years between 2011 and 2030. Table A1.4 presents the Defra background concentrations for the year 2013 for the grid square the Site is located within (455500, 223500).

Table A1.4: Defra Background Maps in 2013 for the Grid Squares at the Location of the Site

| Pollutant | Annual Mean Concentration ($\mu g/m^3$) |
|---|---|
| $NO_x$ | 18.3 |
| $NO_2$ | 13.2 |
| $PM_{10}$ | 18.0 |
| $PM_{2.5}$ | 11.9 |

1.22 The data in Table A1.3 and A1.4 shows that the 2013 monitored urban background $NO_2$ concentrations at the Villiers Road diffusion tube ($19.8\mu g/m^3$) and Tarnarisk Gardens diffusion tube ($17.4\mu g/m^3$) are higher than the total Defra background map ($13.2\mu g/m^3$). For a conservative assessment, background annual mean $NO_2$ concentrations have been obtained from the Villiers Road diffusion tube, this was agreed with the EHO at CDC.

1.23 Background concentrations data used within the assessment are presented in Table A1.5.

Table A1.5: Background Concentrations (µg/m$^3$) Used within the Assessment

| Pollutant | Source | 2013 | 2031/2046^ |
|---|---|---|---|
| $NO_x$ | Defra background maps | 18.3 | 11.4 |
| $NO_2$ | CDC Diffusion Tube | 19.8 | 12.8* |
| $PM_{10}$ | Defra background maps | 18.0 | 16.6 |
| $PM_{2.5}$ | Defra background maps | 11.9 | 10.6 |

Notes: ^ 2030 is the latest forecast year available for background projections. It is assumed that 2031 and 2046 background concentrations will remain at 2030 levels.

* 2013 concentration multiplied by 0.647 (ratio obtained from the Defra background map)

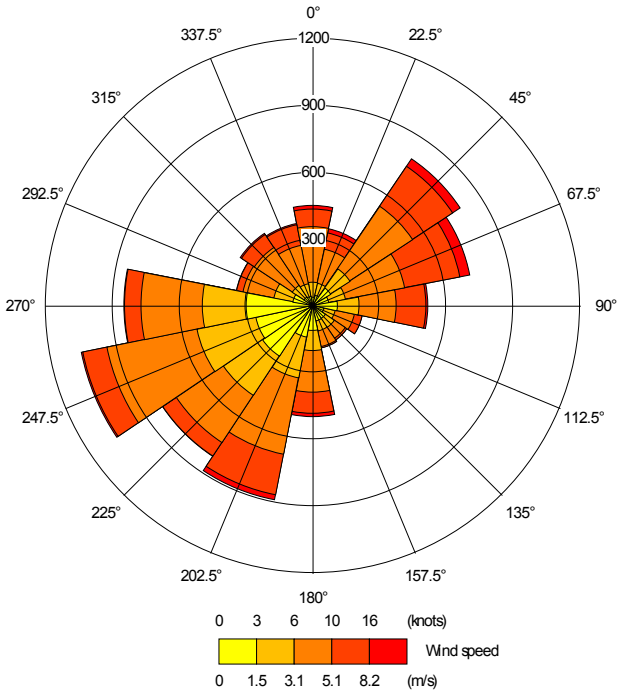
## Meteorological Data

1.24 Local meteorological conditions strongly influence the dispersal of pollutants. Key meteorological data for dispersion modelling include hourly sequential data for wind direction, wind speed, temperature, precipitation and the extent of cloud cover for each hour of a given year. As a minimum ADMS-Roads requires wind speed, wind direction, and cloud cover.

1.25 Meteorological data to input into the model were obtained from the Brize Norton Meteorological Station, which is the closest to the Site and considered to be the most representative. The 2013 data were used to be consistent with the base traffic year and model verification year. It was also used for the 2031 scenarios and the 2046 cumulative scenarios for the air quality assessment. Figure A1.2 presents the wind-rose for the meteorological data.

1.26 Most dispersion models do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75 m/s. It is recommended in Technical Guidance LAQM.TG(09) that the meteorological data file be tested within a dispersion model and the relevant output log file checked, to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedences. Technical Guidance LAQM.TG(09) recommends that meteorological data should only be used if the percentage of usable hours is greater than 75%, and preferably 90%. 2013 meteorological data from Brize Norton include 8,728 lines of usable hourly data out of the total 8,760 for the year, i.e. 99.6% of usable data. This is above the 75% threshold, and is therefore adequate for the dispersion modelling.

Figure A1.2: 2013 Wind Rose for the Brize Norton Meteorological Site




## Model Data Processing

1.27 The modelling results were processed to calculate the averaging periods required for comparison with the AQS objectives.

1.28 $NO_x$ emissions from combustion sources (including vehicle exhausts) comprise principally nitric oxide (NO) and nitrogen dioxide ($NO_2$). The emitted nitric oxide reacts with oxidants in the air (mainly ozone ($O_3$)) to form more $NO_2$. Since only $NO_2$ is associated with effects on human health, the air quality standards for the protection of human health are based on $NO_2$ and not total $NO_x$ or NO.

1.29 The ADMS-Roads model was run without the Chemistry Reaction option to allow verification (see below). Therefore, a suitable $NO_X$:$NO_2$ conversion needed to be applied to the modelled $NO_X$ concentrations. There are a variety of different approaches to dealing with $NO_X$:$NO_2$ relationships, a number of which are widely recognised as being acceptable. However, the current approach was developed for roadside sites, and is detailed within Technical Guidance LAQM.TG(09).

1.30 The LAQM Support website provides a spreadsheet calculator[4] to allow the calculation of $NO_2$ from $NO_x$ concentrations, accounting for the difference between primary emissions of $NO_x$ and background $NO_x$, the concentration of $O_3$, and the different proportions of primary $NO_2$ emissions, in different years. This approach is only applicable to annual mean concentrations.

1.31 LAQM.TG(09) paragraph 2.29 states that where stacks are included within models representing wider urban areas and where the annual mean concentrations are the main focus (as is the case in this assessment) then the spreadsheet calculator, described above, can be used for the conversion of total annual mean $NO_X$ to annual average $NO_2$ concentrations. This guidance was followed for the assessment $NO_x$ concentrations due to the heating plant emissions.

1.32 Research[5] undertaken in support of LAQM.TG(09) has indicated that the 1-hour mean AQS objective for $NO_2$ is unlikely to be exceeded at a roadside location where the annual-mean $NO_2$ concentration is less than 60µg/m$^3$. The 1-hour mean objective is, therefore, not considered further within this assessment where the annual mean $NO_2$ concentration is predicted to be less than 60µg/m$^3$.

1.33 In order to calculate the number of $PM_{10}$ 24-hour means exceeding 50µg/m$^3$ the relationship between the number of 24-hour mean exceedences and the annual mean $PM_{10}$ concentration from LAQM.TG (09)[1] was applied as follows:

$$\textbf{Number of Exceedances} = -18.5+0.00145 \times (\text{annual mean}^3) + \frac{206}{\text{annual mean}}$$

## Other Model Parameters

1.34 There are a number of other parameters that are used within the ADMS-Roads model which are described here for completeness and transparency:

- The model requires a surface roughness value to be inputted. A value of 1.0 was used, which is representative of the study area;
- The model requires the Monin-Obukov length (a measure of the stability of the atmosphere) to be inputted. A value of 30m (representative of mixed urban) was used for the modelling.

## Model Verification

1.35 Model verification is the process of comparing monitored and modelled pollutant concentrations for the same year, at the same locations, and adjusting modelled concentrations if necessary to be consistent with monitoring data. This increases the robustness of modelling results.

1.36 Discrepancies between modelled and measured concentrations can arise for a number of reasons, for example:

- Traffic data uncertainties;
- Background concentration estimates;
- Meteorological data uncertainties;
- Sources not explicitly included within the model (e.g. car parks and bus stops);
- Overall model limitations (e.g. treatment of roughness and meteorological data, treatment of speeds); and
- Uncertainty in monitoring data, particularly diffusion tubes.

1.37 Verification is the process by which uncertainties such as those described above are investigated and minimised. Disparities between modelling and monitoring results are likely to arise as result of a combination of all of these aspects.

## Nitrogen Dioxide

1.38 The ADMS-Roads model was run to predict annual mean $NO_x$ concentrations at five roadside CDC diffusion tube locations.

1.39 As highlighted above, the $NO_2$ concentrations are a function of $NO_x$ concentrations. Therefore, the roadside $NO_x$ concentration predicted by the model was converted to $NO_2$ using the $NO_x$ to $NO_2$ calculator provided by Defra on the air quality archive. The background data for 2013, as presented in Table A1.5 were used.

1.40 The modelled and equivalent measured roadside $NO_2$ concentrations at the diffusion tube sites were compared as shown in Table A1.6 below.

Table A1.6: 2013 Annual Mean $NO_2$ Modelled and Monitored Concentrations

| Site ID | Monitored Annual Mean $NO_2$ ($\mu g/m^3$) | Modelled Total Annual Mean $NO_2$ ($\mu g/m^3$) | % Difference (modelled – monitored) |
|---|---|---|---|
| DT3 Kings End South | 48.5 | 32.0 | -34.1 |
| DT4 Kings End North | 35.8 | 26.5 | -26.0 |
| DT5 Field Street | 38.6 | 35.0 | -9.3 |
| DT6 North Street | 42.7 | 34.2 | -19.9 |
| DT7 Queens Avenue | 41.0 | 30.5 | -25.7 |

1.41 Table A1.6 indicates that the model under predicts annual mean $NO_2$ concentrations at the five diffusion tube locations. Technical Guidance LAQM.TG(09) suggests that where there is disparity between modelled and monitored results, particularly if this is by more than 25%, appropriate adjustment should be undertaken.

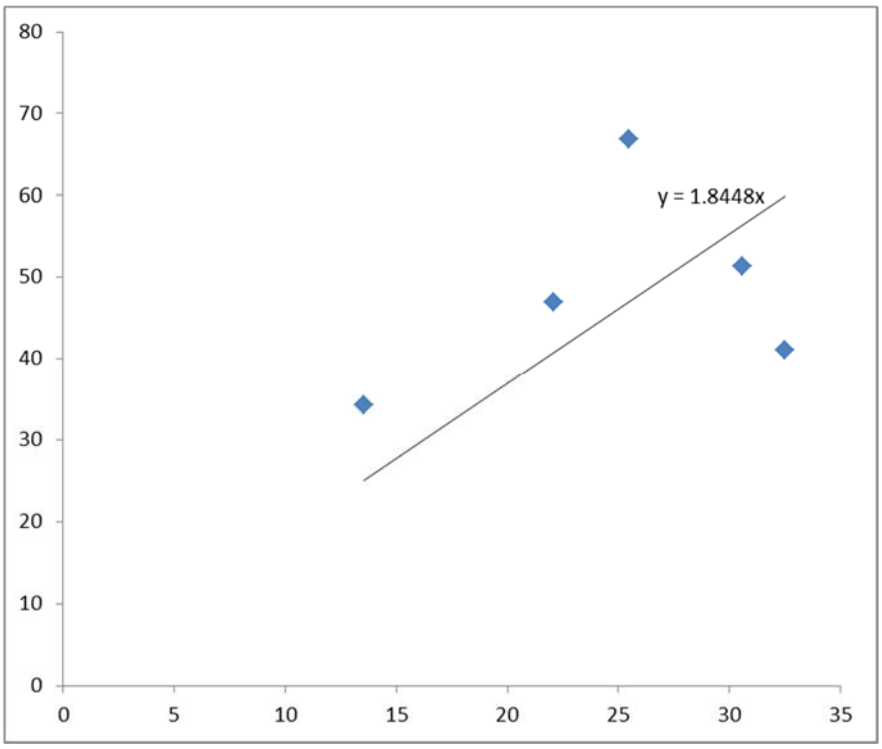
1.42 LAQM.TG(09) presents a number of methods for approaching model verification and adjustment. Example 2, of Annex 3 in the LAQM.TG (09) guidance document, indicates a method based on adjusting $NO_2$ road contribution and calculating a single adjustment factor. This method refers to modelling based on road traffic sources and can be applied to either a single diffusion tube location, or where numerous diffusion tube monitoring locations are sited within the modelled area. This requires the roadside $NO_x$ contribution to be calculated. In addition, monitored $NO_x$ concentrations are required, which have been calculated from the annual mean $NO_2$ concentration at the diffusion tube site using the $NO_x$ to $NO_2$ spreadsheet calculator as described above. The steps involved in the adjustment process are presented in Table A1.7.

Table A1.7: Model Verification Result for Adjustment $NO_x$ Emissions ($\mu g/m^3$)

| Site ID | Monitored $NO_2$ | Monitored $NO_x$ | Monitored Road $NO_2$ | Monitored Road $NO_x$ | Modelled Road $NO_x$ | Ratio of Monitored Road Contribution $NO_x$/Modelled Road Contribution $NO_x$ |
|---|---|---|---|---|---|---|
| DT3 | 48.5 | 85.4 | 28.7 | 66.9 | 25.5 | 2.6 |
| DT4 | 35.8 | 52.8 | 16.0 | 34.3 | 13.6 | 2.5 |
| DT5 | 38.6 | 59.5 | 18.8 | 41.0 | 32.5 | 1.3 |
| DT6 | 42.7 | 69.8 | 22.9 | 51.3 | 30.6 | 1.7 |
| DT7 | 41.0 | 65.5 | 21.2 | 47.0 | 22.1 | 2.1 |
| | | | | | **Adjustment Factor** | **1.8448** |

1.43 Figure A1.3 shows the mathematical relationship between modelled and monitored roadside $NO_x$ (i.e. total $NO_x$ minus background $NO_x$) in a scatter graph (data taken from Table A1.7), with a trendline passing through zero and its derived equation.

Figure A1.3: Unadjusted Modelled versus Monitored Annual Mean Roadside $NO_x$ at the Monitoring Sites (µg/m$^3$)




1.44 Consequently in Table A1.8 the adjustment factor (1.8448) obtained from Figure A1.3 is applied to the modelled $NO_x$ Roadside concentrations to obtain improved agreement between monitored and modelled annual mean $NO_x$. This has been converted to annual mean $NO_2$ using the $NO_x$:$NO_2$ spreadsheet calculator.

Table A1.8: Final Adjusted Annual Average $NO_2$ Concentrations Compared to Monitored Annual Mean $NO_2$ Concentrations (µg/m$^3$)

| Site ID | Adjusted Modelled Road $NO_x$ | Adjusted Modelled Total $NO_x$ | Modelled Total $NO_2$ | Monitored Total $NO_2$ | % Difference |
|---|---|---|---|---|---|
| DT3 | 47.0 | 65.5 | 41.0 | 48.5 | -15.5 |
| DT4 | 25.0 | 43.5 | 31.8 | 35.8 | -11.3 |
| DT5 | 59.9 | 78.4 | 46.0 | 38.6 | 19.1 |
| DT6 | 56.5 | 75.0 | 44.7 | 42.7 | 4.6 |
| DT7 | 40.8 | 59.3 | 38.5 | 41.0 | -6.1 |

1.45 The data in Table A1.8 indicates an improved agreement between monitored and modelled annual mean $NO_2$ results compared to the unadjusted/unverified model.

1.46 The $NO_x$ adjustment process was subsequently applied to all of roadside $NO_x$ modelling for 2013 and 2031 'without' and 'with' the Development in place, at the specific receptors locations assessed, before heating plant concentrations were added and before the predicted concentrations were converted to $NO_2$.

## Particulate Matter ($PM_{10}$ and $PM_{2.5}$)

1.47 $PM_{10}$ and $PM_{2.5}$ monitoring data is not available for the Site area. Therefore, the roadside modelled $NO_x$ adjustment factor of 1.8448 was applied to all the roadside $PM_{10}$ and $PM_{2.5}$ modelling results, before adding on the background concentrations, for the study area for 2013 and each of the 2031 scenarios, at the specific receptors locations assessed, and before the number of daily exceedences was calculated.

### Verification Summary

1.48 Any atmospheric dispersion model study will always have a degree of inaccuracy due to a variety of factors. These include uncertainties in traffic emissions data, in the differences between available meteorological data and the specific microclimate at each receptor location, simplifications made in the model algorithms that describe the atmospheric dispersion and chemical processes. There will also be uncertainty in the comparison of predicted concentrations with monitored data, given the potential for errors and uncertainty in sampling methodology (technique, location, handling, and analysis) as well as processing of any monitoring data.

1.49 Whilst systematic under or over prediction can be taken in to account through the model verification / adjustment process, random errors will inevitably occur and a level of uncertainty will still exist in corrected / adjusted data.

1.50 Model uncertainties arise because of limited scientific knowledge, limited ability to assess the uncertainty of model inputs, for example, emissions from vehicles, poor understanding of the interaction between model and / or emissions inventory parameters, sampling and measurement error associated with monitoring sites and whether the model itself completely describes all the necessary atmospheric processes.

1.51 Overall, it is concluded that with the adjustment factors applied to the ADMS-Roads model, it is performing well and modelled results are considered to be suitable to determine the effects of the Development on local air quality.

## $NO_2$ Sensitivity Test

1.52 Whilst this air quality assessment was based on current guidance, i.e., with reduced emission rates and background concentration for the completion year of 2031, to take into account the trend that $NO_x$ and $NO_2$ concentrations are not declining as expected[1], a sensitivity test has been carried out, on the basis of no future reductions in road traffic emission rates and background concentrations (i.e. considering the potential effect of the Himley Village Development against the current baseline, 2013, conditions). Modelled results of this additional scenario are presented in Table A1.9.

Table A1.9: Results of the ADMS-Roads Modelling at Sensitive Receptors, Assuming No Improvement in $NO_x$ and $NO_2$

| Receptor ID | 2031 Without Development | 2031 With Development | 2031 Change |
|---|---|---|---|
| 1 | 24.2 | 24.5 | 0.3 |
| 2 | 24.2 | 25.2 | 1.0 |
| 3 | 23.4 | 24.5 | 1.1 |
| 4 | 28.0 | 28.6 | 0.6 |
| 5 | 24.8 | 25.0 | 0.3 |

| Receptor ID | 2031 Without Development | 2031 With Development | 2031 Change |
|---|---|---|---|
| 6 | 27.5 | 27.7 | 0.2 |
| 7 | 28.1 | 28.3 | 0.2 |
| 8 | 22.4 | 22.4 | 0.1 |
| 9 | 22.8 | 22.9 | 0.1 |
| 10 | 28.2 | 28.4 | 0.2 |
| 11 | 25.9 | 26.0 | 0.1 |
| 12 | 30.4 | 30.7 | 0.3 |
| 13 | 30.9 | 31.2 | 0.2 |
| 14 | 26.4 | 26.5 | 0.2 |
| 15 | 26.5 | 26.5 | 0.0 |
| 16 | 28.2 | 28.4 | 0.2 |
| 17 | 31.8 | 32.1 | 0.2 |
| 18 | 22.6 | 22.9 | 0.2 |
| 19 | 29.4 | 29.4 | -0.1 |
| 20 | 28.6 | 28.9 | 0.3 |
| 21 | 28.3 | 29.2 | 0.9 |
| 22 | 26.9 | 27.1 | 0.2 |
| 23 | **43.7** | **44.4** | 0.6 |
| 24 | 23.3 | 23.5 | 0.2 |
| 25 | **52.8** | **53.8** | 1.0 |
| 26 | 24.7 | 24.7 | 0.0 |
| 27 | **43.4** | **44.1** | 0.7 |
| 28 | 38.3 | 38.8 | 0.5 |
| 29 | **42.2** | **42.8** | 0.6 |
| 30 | 34.5 | 34.8 | 0.3 |
| 31 | 26.4 | 26.6 | 0.2 |
| 32 | 25.7 | 25.8 | 0.1 |
| 33 | 26.4 | 26.5 | 0.0 |
| 34 | - | 25.0 | - |
| 35 | - | 24.4 | - |

Note: Exceedences of the AQS objective highlighted in **Bold**

1.53 Table A1.10 summarises the magnitude of change (as outlined in Table 9.6 of the ES chapter) and the significance of effects (as outlined in Table 9.7 of the ES chapter) for annual mean $NO_2$ concentrations 'with' the Development, assuming no improvements to $NO_x$ and $NO_2$. The changes in pollutant concentrations, and absolute pollutant concentrations, presented in this sensitivity analysis, and therefore the effect significance criteria, will be less than those presented as the Euro 6 emission standards will take effect post 2015.

Table A1.10: Magnitude of Change and Significant of Effects for Annual Mean $NO_2$ Concentrations with the Development in 2031, Assuming No Improvement in $NO_x$ and $NO_2$

| ID | Receptor Location | Magnitude of Change (see Table9.6 of the ES chapter) | Significance (dependent on magnitude of change and magnitude of concentration see Table 9.7 of the ES chapter) |
|---|---|---|---|
| 1 | | Imperceptible | Negligible |
| 2 | | Small | Negligible |
| 3 | | Small | Negligible |
| 4 | | Small | Negligible |
| 5 | | Imperceptible | Negligible |
| 6 | | Imperceptible | Negligible |
| 7 | | Imperceptible | Negligible |
| 8 | | Imperceptible | Negligible |
| 9 | | Imperceptible | Negligible |
| 10 | | Imperceptible | Negligible |
| 11 | | Imperceptible | Negligible |
| 12 | | Imperceptible | Negligible |
| 13 | | Imperceptible | Negligible |
| 14 | | Imperceptible | Negligible |
| 15 | | Imperceptible | Negligible |
| 16 | | Imperceptible | Negligible |
| 17 | | Imperceptible | Negligible |
| 18 | | Imperceptible | Negligible |
| 19 | | Imperceptible | Negligible |
| 20 | | Imperceptible | Negligible |
| 21 | | Small | Negligible |
| 22 | | Imperceptible | Negligible |
| 23 | | Small | Minor Adverse |
| 24 | | Imperceptible | Negligible |
| 25 | | Small | Minor Adverse |
| 26 | | Imperceptible | Negligible |
| 27 | | Small | Minor Adverse |
| 28 | | Small | Minor Adverse |
| 29 | | Small | Minor Adverse |
| 30 | | Imperceptible | Negligible |
| 31 | | Imperceptible | Negligible |
| 32 | | Imperceptible | Negligible |
| 33 | | Imperceptible | Negligible |

## References


1 http://laqm.defra.gov.uk/faqs/faqs.html: Measured nitrogen oxides ($NO_x$) and/or nitrogen dioxide ($NO_2$) concentrations in my local authority area do not appear to be declining in line with national forecasts.

2 Defra, 2009, Local Air Quality Management Technical Guidance LAQM.TG(09)

3 Department for Transport (DfT) Statistics, www.dft.gov.uk/statistics/series/traffic

4 AEA, $NO_X$ to $NO_2$ Calculator, http://laqm1.defra.gov.uk/review/tools/monitoring/calculator.php Version 4.1, 19 June 2014

5 AEA, 'Analysis of the relationship between annual-mean nitrogen dioxide concentration and exceedences of the 1-hour mean AQS Objective', 2008.

# APPENDIX 10.1
# ACOUSTIC GLOSSARY

# Appendix 10.1 Acoustic Glossary

**Ambient sound**
The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.

**Assessment period**
The period in a day over which assessments are made.

**A-weighting**
A frequency weighting applied to measured or predicted sounds levels in order to compensate for the non-linearity of human hearing.

**Background noise**
Background noise is the term used to describe the noise measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the $L_{90}$ noise level (see below).

**Broadband**
Containing the full range of frequencies.

**Decibel [dB]**
The level of noise is measured objectively using a Sound Level Meter. This instrument has been specifically developed to mimic the operation of the human ear. The human ear responds to minute pressure variations in the air. These pressure variations can be likened to the ripples on the surface of water but of course cannot be seen. The pressure variations in the air cause the eardrum to vibrate and this is heard as sound in the brain. The stronger the pressure variations, the louder the sound that is heard.

The range of pressure variations associated with everyday living may span over a range of a million to one. On the top range may be the sound of a jet engine and on the bottom of the range may be the sound of a pin dropping.

Instead of expressing pressure in units ranging from a million to one, it is found convenient to condense this range to a scale 0 to 120 and give it the units of decibels. The following are examples of the decibel readings of every day sounds;

| | |
|---|---|
| Four engine jet aircraft at 100m | 120 dB |
| Riveting of steel plate at 10m | 105 dB |
| Pneumatic drill at 10m | 90 dB |
| Circular wood saw at 10m | 80 dB |
| Heavy road traffic at 10m | 75 dB |
| Telephone bell at 10m | 65 dB |
| Male speech, average at 10m | 50 dB |
| Whisper at 10m | 25 dB |
| Threshold of hearing, 1000 Hz | 0 dB |

**dB(A): A-weighted decibels**
The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the 'A' filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.

**Do-Minimum**
Describes a scenario under which the road scheme that is under consideration does not proceed.

**Façade Noise Level**
A noise level measured or predicted at the façade of a building, typically at a distance of 1m, containing a contribution made up of reflections from the façade itself (+3dB).

**$L_{Amax}$ noise level**
This is the maximum noise level recorded over the measurement period.

**$L_{Amin}$ noise level**
This is the lowest level during the measurement period.

| | |
|---|---|
| **$L_{Aeq,T}$ noise level** | This is the 'equivalent continuous A-weighted sound pressure level, in decibels' and is defined in British Standard 7445 as the 'value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T, has the same mean square sound pressure as a sound under consideration whose level varies with time'.<br>It is a unit commonly used to describe construction noise, noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise. |
| **$L_{A90}$ noise level** | This is the noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during quieter periods. It is often referred to as the background noise level and is used in the assessment of disturbance from industrial noise. |
| **$L_{A10}$ noise level** | This is the noise level which is achieved for 10% of the monitoring period and is often used to describe road traffic noise |

# APPENDIX 10.2
# BASELINE NOISE SURVEY

# APPENDIX 10.2: BASELINE NOISE SURVEY

## Noise Survey Procedure and Results

A baseline noise survey was undertaken over a typical 24hr period between the 13h and the 14th October 2010 by Hyder Consulting Ltd. Noise monitoring locations were selected to be representative of both existing and proposed sensitive receptors. Unattended sound level meters were installed at 6 locations with 2 attended short term measurements adjacent to key roads. The attended short-term measurements were conducted following the shortened measurement method outlined in CRTN.

The parameters logged throughout the survey period were $L_{Aeq}$, $L_{Amax}$, $L_{A90}$ and $L_{A10}$. The $L_{Aeq}$ level is the equivalent continuous sound pressure level over the measurement period; LAmax is an indicator of the highest sound level during the measurement period; LA90 is used as a descriptor of background noise levels and $L_{A10}$ is the noise level which is achieved for 10% of the monitoring period and is often used to describe road traffic noise.

Table 10.2.1 presents the noise monitoring locations which are illustrated in Figure 10.1 of Volume 1 of the Environmental Statement.

Table 10.2.1: Noise Monitoring Locations

| Monitoring Location (refer to Figure 10.1) | Description | Observations and Predominant Noise Sources |
|---|---|---|
| LTN1 | Long-term noise monitoring location representative of the north eastern boundary | Dominant noise source is road traffic along B4100 |
| LTN2 | Long-term noise monitoring location representative of Howes Lane | Dominant noise source is road traffic along Howes Lane/A4095 |
| LTN3 | Long-term noise monitoring location representative of Bucknell Road | Dominant noise source is road traffic along Bucknell Road |
| LTN4 | Long-term noise monitoring location representative of railway | Dominant noise sources is railway noise. |
| LTN5 | Long-term noise monitoring location representative of south east boundary | Dominant noise source is road traffic along Howes Lane/A4095 |
| LTN6 | Long-term noise monitoring location representative of southern boundary | Dominant noise source is road traffic along Stoney Middleton Lane |
| STN1 | Shortened CRTN measurement adjacent to M40 | Road traffic noise M40 dominates |
| STN2 | Shortened CRTN measurement adjacent to Bucknell Road | Road traffic noise from Bucknell Road dominates |

Figures 10.2.1 to 10.2.6 present the result graphically for the long-term unattended noise monitoring locations.

Figure 10.2.1: Time History Plot – LTN1

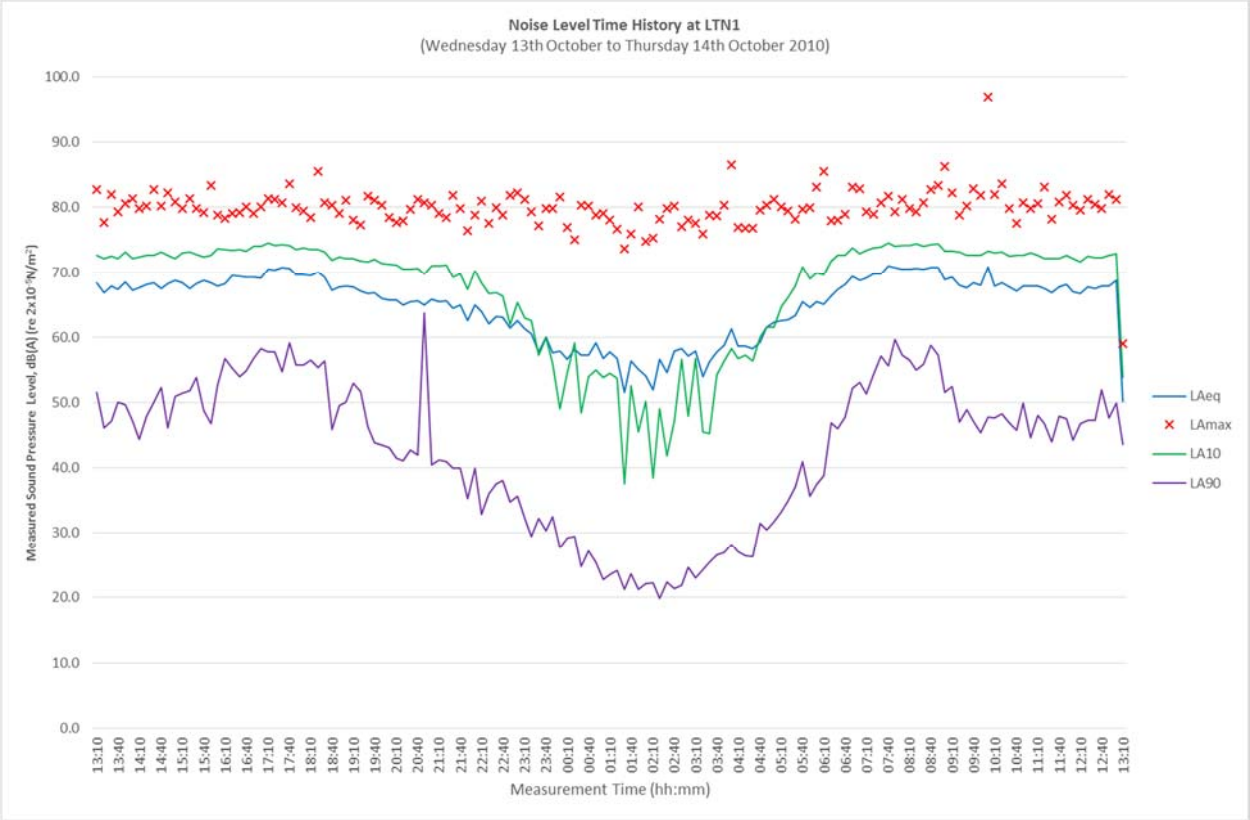



Figure 10.2.2: Time History Plot – LTN2

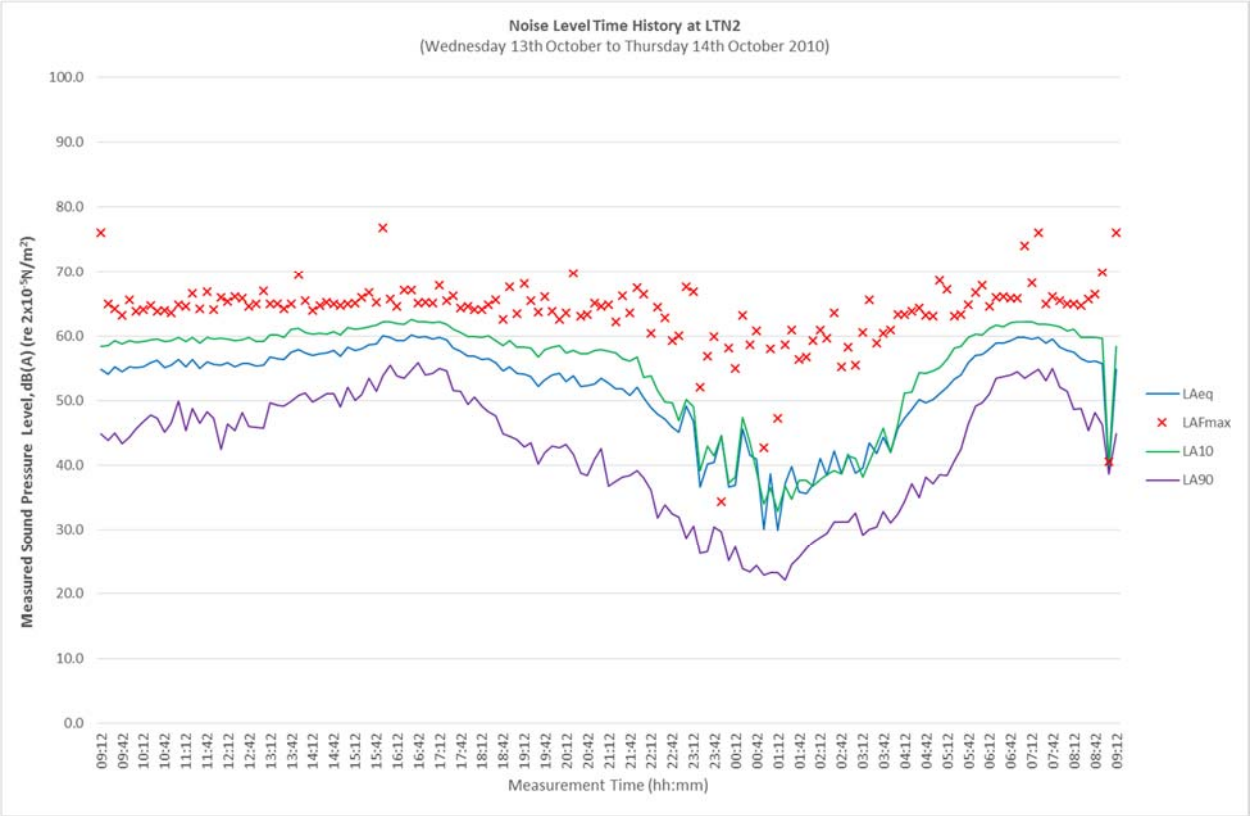



Figure 10.2.3: Time History Plot – LTN3

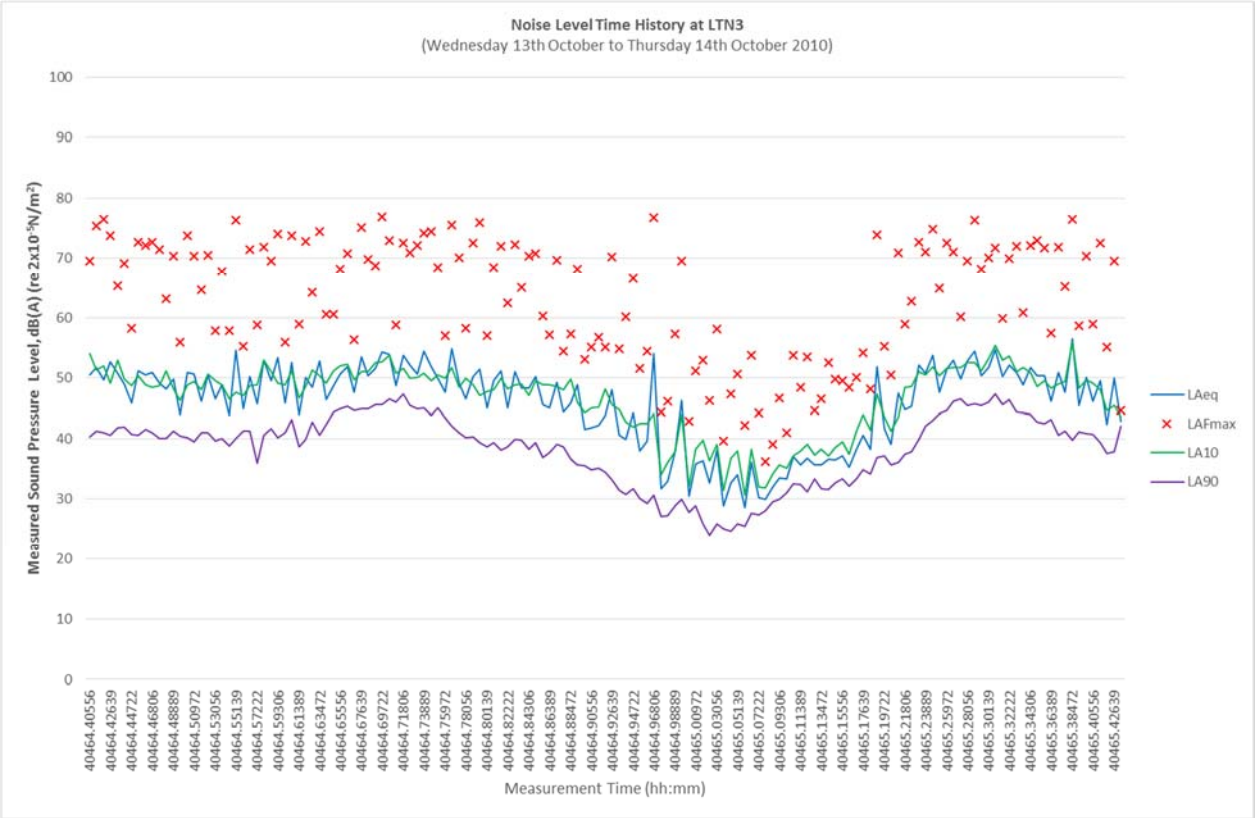



Figure 10.2.4: Time History Plot – LTN4

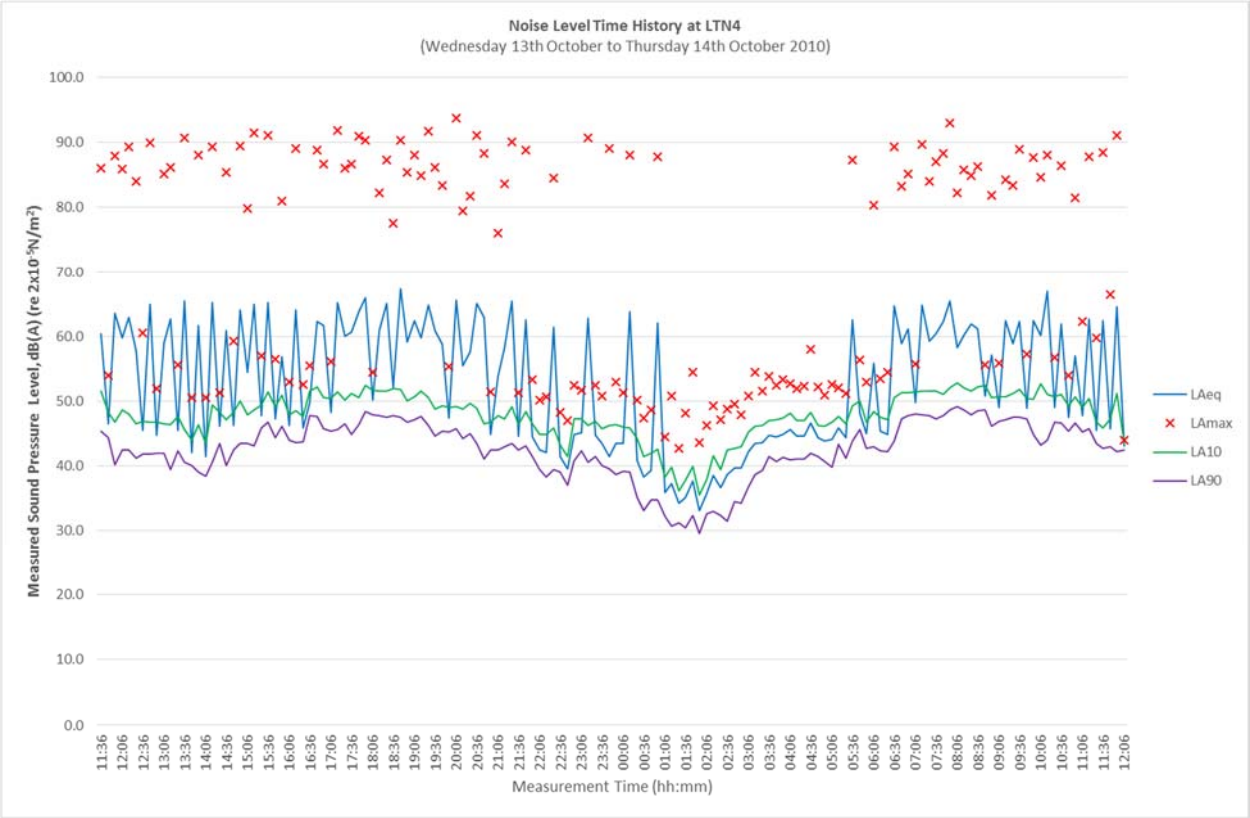



Figure 10.2.5: Time History Plot – LTN5

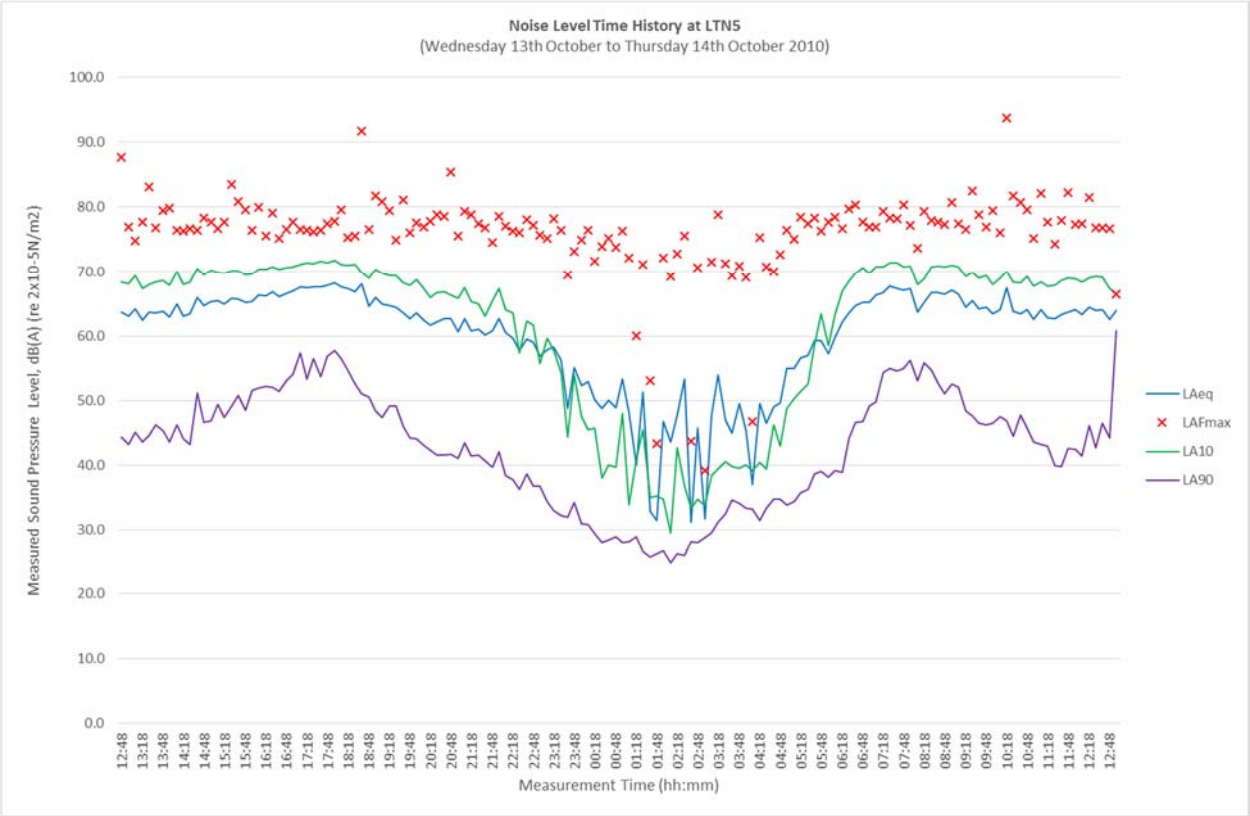
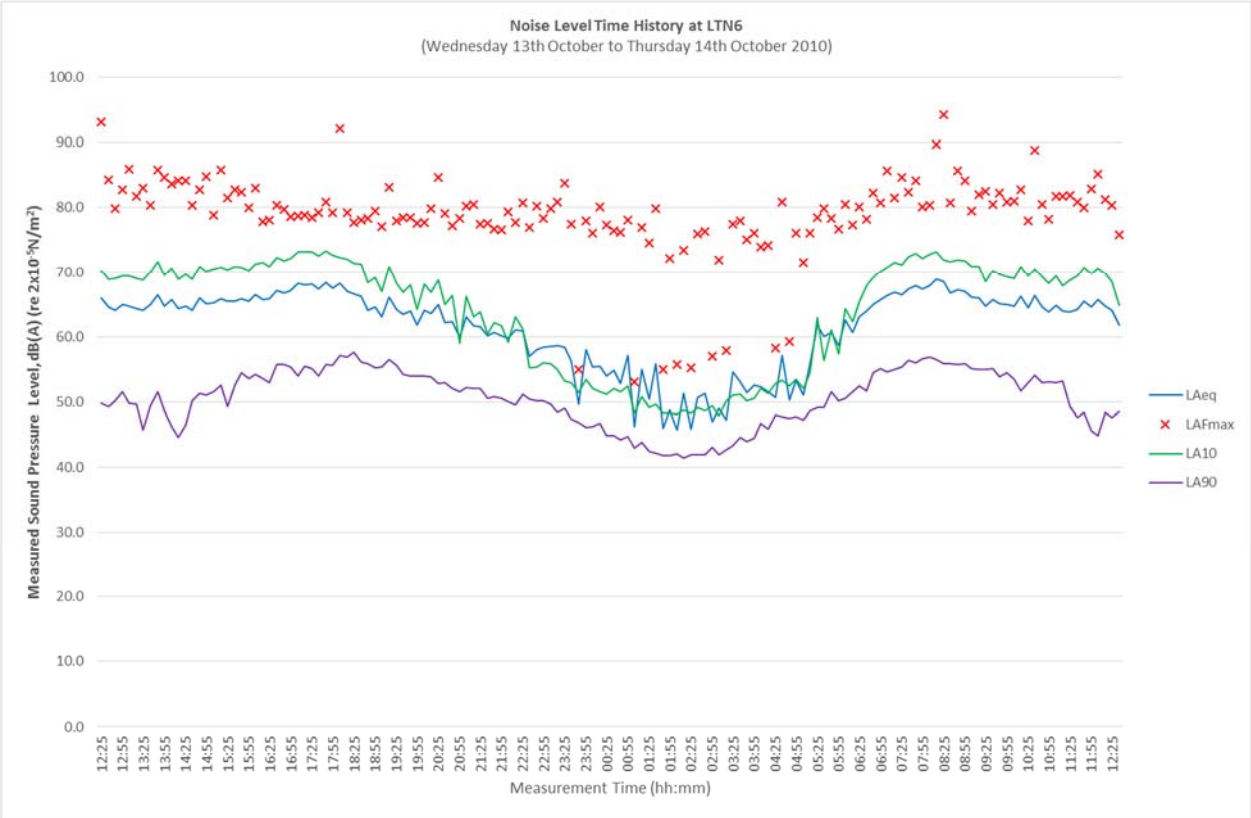



Figure 10.3.6: Time History Plot – LTN6




Full results of the short-term noise measurements are provided below.

Table 10.2.2 presents the noise monitoring data for STN1 adjacent to the M40 and Table 10.2.3 presents the noise monitoring data for STN1 adjacent to Bucknell Road.

Table 10.2.2: STN1 – Adjacent to M40 Noise Monitoring Data

| Date / Time | Measurement Time | LAeq | LAmax | LA10 | LA90 |
|---|---|---|---|---|---|
| 13/10/2010 14:50 | 00:09:59 | 83.6 | 87.9 | 85.6 | 81.0 |
| 13/10/2010 15:00 | 00:10:00 | 83.8 | 88.0 | 85.7 | 81.4 |
| 13/10/2010 15:10 | 00:09:59 | 83.7 | 88.3 | 85.7 | 81.1 |
| 13/10/2010 15:20 | 00:09:59 | 83.8 | 88.0 | 85.7 | 81.7 |
| 13/10/2010 15:30 | 00:09:59 | 83.8 | 87.8 | 85.7 | 81.9 |
| 13/10/2010 15:40 | 00:09:59 | 84.0 | 89.0 | 86.0 | 81.6 |
| 13/10/2010 15:50 | 00:09:59 | 83.9 | 88.1 | 85.8 | 82.4 |
| 13/10/2010 16:00 | 00:10:00 | 84.2 | 88.7 | 86.0 | 82.2 |
| 13/10/2010 16:10 | 00:09:59 | 84.0 | 88.4 | 85.8 | 82.2 |
| 13/10/2010 16:20 | 00:09:59 | 84.4 | 88.9 | 86.1 | 82.5 |
| 13/10/2010 16:30 | 00:09:59 | 84.3 | 88.4 | 85.9 | 82.5 |
| 13/10/2010 16:40 | 00:09:59 | 84.5 | 90.1 | 86.2 | 81.9 |
| 13/10/2010 16:50 | 00:09:59 | 84.6 | 88.4 | 86.1 | 81.0 |
| 13/10/2010 17:00 | 00:09:59 | 84.7 | 89.0 | 86.3 | 81.4 |

| Date / Time | Measurement Time | LAeq | LAmax | LA10 | LA90 |
|---|---|---|---|---|---|
| 13/10/2010 17:10 | 00:09:59 | 84.7 | 88.5 | 86.4 | 81.1 |
| 13/10/2010 17:20 | 00:09:59 | 84.6 | 88.6 | 86.2 | 81.7 |
| 13/10/2010 17:30 | 00:09:59 | 84.8 | 89.5 | 86.3 | 81.9 |
| 13/10/2010 17:40 | 00:10:00 | 84.6 | 88.1 | 86.2 | 81.6 |
| | | | | | |
| 14/10/2010 02:11 | 00:09:59 | 73.8 | 85.4 | 78.2 | 55.6 |
| 14/10/2010 02:21 | 00:10:00 | 72.8 | 86.1 | 77.5 | 54.6 |
| 14/10/2010 02:31 | 00:10:00 | 73.7 | 85.5 | 78.2 | 53.8 |
| 14/10/2010 02:41 | 00:09:59 | 74.2 | 86.6 | 78.4 | 56.9 |
| 14/10/2010 02:51 | 00:10:03 | 73.5 | 85.2 | 78.0 | 56.1 |
| 14/10/2010 03:01 | 00:10:00 | 73.7 | 86.0 | 78.0 | 56.7 |

STN2 Bucknell Road

| Date / Time | Measurement Time | LAeq | LAmax | LA10 | LA90 |
|---|---|---|---|---|---|
| 14/10/2010 10:00 | 00:09:59 | 62.6 | 76.7 | 67.2 | 45.5 |
| 14/10/2010 10:10 | 00:10:00 | 59.8 | 75.6 | 64.7 | 43.2 |
| 14/10/2010 10:20 | 00:10:00 | 60.3 | 78.0 | 64.2 | 43.3 |
| 14/10/2010 10:30 | 00:09:59 | 59.5 | 74.5 | 63.8 | 43.0 |
| 14/10/2010 10:40 | 00:10:00 | 58.4 | 73.8 | 62.2 | 42.0 |
| 14/10/2010 10:50 | 00:10:00 | 57.8 | 73.2 | 61.1 | 42.0 |
| 14/10/2010 11:00 | 00:09:59 | 58.6 | 72.6 | 63.0 | 44.2 |
| 14/10/2010 11:46 | 00:09:59 | 57.7 | 73.9 | 61.1 | 40.9 |
| 14/10/2010 11:56 | 00:09:59 | 57.7 | 71.6 | 61.9 | 49.1 |
| 14/10/2010 12:06 | 00:10:00 | 57.7 | 72.3 | 62.0 | 43.6 |
| 14/10/2010 12:16 | 00:09:59 | 56.2 | 71.5 | 60.3 | 40.2 |
| 14/10/2010 12:26 | 00:09:59 | 56.8 | 75.3 | 60.7 | 38.0 |
| 14/10/2010 12:36 | 00:09:59 | 59.1 | 72.9 | 63.6 | 39.4 |
| 14/10/2010 12:46 | 00:09:59 | 58.3 | 73.1 | 63.1 | 38.0 |
| 14/10/2010 12:56 | 00:10:00 | 58.0 | 78.1 | 62.5 | 38.6 |
| 14/10/2010 13:06 | 00:10:00 | 59.0 | 71.7 | 64.3 | 38.9 |
| 14/10/2010 13:16 | 00:09:59 | 58.5 | 73.2 | 63.4 | 37.2 |
| 14/10/2010 13:26 | 00:10:00 | 58.6 | 73.9 | 62.8 | 38.4 |
| | | | | | |
| 15/10/2010 02:02 | 00:09:59 | 36.7 | 46.1 | 38.3 | 33.8 |
| 15/10/2010 02:12 | 00:09:59 | 53.0 | 79.3 | 42.9 | 35.5 |
| 15/10/2010 02:22 | 00:10:00 | 38.2 | 44.8 | 39.5 | 36.2 |
| 15/10/2010 02:32 | 00:09:59 | 48.0 | 73.1 | 40.7 | 65.9 |

| Date / Time | Measurement Time | LAeq | LAmax | LA10 | LA90 |
|---|---|---|---|---|---|
| 15/10/2010 02:42 | 00:09:59 | 54.0 | 78.8 | 47.9 | 36.8 |
| 15/10/2010 02:52 | 00:09:59 | 55.0 | 83.0 | 41.1 | 36.8 |
| 15/10/2010 03:02 | 00:02:07 | 39.1 | 46.5 | 41.4 | 35.5 |

# APPENDIX 10.3
# CONSTRUCTION ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

# Appendix 10.3: Construction Assessment Methodology and Significance Criteria

**Construction Noise Assessment**

The significance criteria for the construction noise assessment are based on 'The ABC Method' from BS 5228-1:2009**+A1:2014**. An extract describing this method is provided below.

**Example Method 1 – The ABC Method**

Table E.1 shows an example of the threshold of **potential** significant effect at dwellings when the total **site** noise level rounded to the nearest decibel, exceeds the listed value. The table can be used as follows: for the appropriate period (night, evening/weekends or day), the ambient noise level is determined and rounded to the nearest 5 dB. This is then compared with the site noise level. If the site noise level exceeds the appropriate category value, then a significance effect is deemed to occur.

Table E.1 **Example threshold of significant effect at dwellings**

| **Assessment category and threshold value period ($L_{Aeq}$)** | **Threshold value, in decibels (dB)** | | |
|---|---|---|---|
| | **Category A[A)]** | **Category B [B)]** | **Category C [C)]** |
| Night-time (23.00-07.00) | 45 | 50 | 55 |
| Evenings and weekends[D)] | 55 | 60 | 65 |
| Daytime (07.00-19.00) and Saturdays (07.00-13.00) | 65 | 70 | 75 |

NOTE1 A **potential significant** effect **is indicated** if the site $L_{AeqT}$ noise level, exceeds the threshold level for the Category appropriate to the ambient noise level.

NOTE 2 If the ambient noise level exceeds the **Category C** threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a **potential** significant effect is **indicated** if the total $L_{Aeq}$ noise level for the period increases by more than 3 dB due to **site noise**.

NOTE 3 Applied to residential receptors only.

A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

B) Category B: threshold values to use when the ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

C) Category C: threshold values to use when the ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

D) 19.00-23.00 weekdays, 13.00-23.00 Saturdays and 07.00-23.00 Sundays.

*(Source: BS 5228-1:2009**+A1:2014**, Page119)*

Table 10.3.1 presents the derived daytime threshold values for the selected representative NSRs. Calculations have not been undertaken for the evening or night-time as it is assumed that evening and night-time construction work would only be undertaken under exceptional circumstances and not without prior approval. Exceptional circumstances may include concreting operations where the pumping of concrete to foundations has to be a continuous process which may require operations outside the daytime period.

Table 10.3. 1 Construction Daytime Threshold Categories (BS 5228 ABC Method)

| NSR Ref. | NSR | Prevailing Noise Level dB $L_{Aeq}$ [1] | BS 5228: Threshold Value |
|---|---|---|---|
| A | Lovelynch House | 65 | 65 |
| B | Gowell Farm | 55 | 65 |
| C | Aldershot Farm | 58 | 65 |
| D | Himley Farm | 51 | 65 |

Note: [1] – Noise levels inferred from Hyder Consulting Ltd baseline noise survey.

Generic calculations were undertaken using the data and procedures set out in BS 5228:2009**+A1:2014** for the noisiest construction phases, to derive indicative noise levels at selected NSRs. The highest noise levels tend to be associated with plant associated with, piling, earthmoving and construction of the substructure and superstructure. During the fit-out, construction noise would be significantly lower. The calculations assume that plant would be operating at the closest point to the NSR, such as the construction Site boundary (hoarding location), and do not take into account any existing or proposed screening. The noisiest construction phases and associated noise levels are as follows:

- Earthworks 85 dB(A) at 10m;
- Piling 85 dB(A) at 10m;;
- Concreting 86 dB(A) at 10m;
- Pavement 80 dB(A) at 10m;

The closest potentially sensitive receptors to the proposed Development are identified in Table 10.3.1 and illustrated in Figure 10.1. The baseline noise levels for each receptor was derived from the most representative monitoring position from the Hyder baseline noise surveys. Suitable threshold levels, above which significant adverse effects may arise, are specified in accordance with the guidance provided in BS 5228:2009**+A1:2014**. All locations due to the derived prevailing noise level have been assigned the lowest threshold level of 65dB $L_{Aeq}$ for the daytime period as defined by BS5228.

A maximum worst case noise level over a one hour period was calculated, assuming that plant would be operating at the closest point to the nearest NSRs in the absence of mitigation. In practice, noise levels would tend to be lower owing to greater separation distance as the works progress. They would also tend to reduce over a 12-hour working day owing to periods of plant inactivity.

Table 10.3.2: Generic Construction Calculations

| NSR | Construction Phase | Threshold Level (dB(A)) | Site Noise Level (dB(A)) No Mitigation | Significance No Mitigation | Site Noise Level (dB(A)) Mitigation | Significance Mitigation |
|---|---|---|---|---|---|---|
| SR A (LT6) | Earth Moving | 65 | 81 | Substantial Adverse | 71 | Moderate Adverse |
| | Piling | 65 | 81 | Substantial Adverse | 71 | Moderate Adverse |
| | Concreting | 65 | 82 | Substantial Adverse | 72 | Moderate Adverse |
| | Road Paving | 65 | 76 | Substantial Adverse | 66 | Minor Adverse |
| SR B (LT5) | Earth Moving | 65 | 65 | Minor Adverse | 55 | Insignificant |
| | Piling | 65 | 65 | Minor Adverse | 55 | Insignificant |
| | Concreting | 65 | 66 | Minor Adverse | 56 | Insignificant |
| | Road Paving | 65 | 60 | Insignificant | 50 | Insignificant |
| SR C (LT5) | Earth Moving | 65 | 63 | Insignificant | 53 | Insignificant |
| | Piling | 65 | 62 | Insignificant | 52 | Insignificant |
| | Concreting | 66 | 62 | Insignificant | 52 | Insignificant |
| | Road Paving | 65 | 57 | Insignificant | 47 | Insignificant |
| SR D (ST2) | Earth Moving | 65 | 81 | Substantial Adverse | 72 | Moderate Adverse |
| | Piling | 65 | 81 | Substantial Adverse | 71 | Moderate Adverse |
| | Concreting | 65 | 82 | Substantial Adverse | 71 | Moderate Adverse |
| | Road Paving | 65 | 76 | Substantial Adverse | 66 | Minor Adverse |

# APPENDIX 10.4
# TRAFFIC NOISE ASSESSMENT

# Appendix 10.4 Traffic Noise Assessment

The significance criteria for Short-Term (opening year within and without Development) and Long-Term (opening year no Development v design year with Development) assessment are presented in Table 10.4.1. The significance criteria have been derived from advice contained within Design Manual for Road and Bridges (DMRB), Volume 11, Part 3, Section 7, Noise (2011).

DMRB details that a change in road traffic noise of 1dB $L_{A10,18h}$ in the short term (eg when a project is opened) is the smallest that is considered perceptible. In the long-term (typically 15 years after project opening), a 3dB $L_{A10,18h}$ change is considered perceptible.

Table 10.4.1: Change in Noise Level and Significance of Effect

| Change in Noise Level Short Term Assessment | Change in Noise Level Long Term Assessment | Significance of Effect |
|---|---|---|
| 0.0 – 0.9 | 0.0 – 2.9 | Insignificant |
| 1.0 – 2.9 | 3.0 – 4.9 | Minor |
| 3.0 – 4.9 | 5.0 – 9.9 | Moderate |
| **≥5** | ≥10 | Substantial |

Table 10.4.2: Operational Development Traffic Noise Assessment 2031 (Short-Term Assessment)

| Himley Village | | Assessment of $L_{A10}$ 18-hour Basic Noise Levels at 10m from Road | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Base Year 2031 | | | 2031 + Development | | | | | | |
| Road | | % HGV | Speed kph | Flow | % HGV | Speed kph | Flow | % Flow Change | Base Year | Base Year + Development | Change |
| 1 | A41 northbound, N of M40 J9 | 7 | 97 | 15774 | 7 | 97 | 15766 | 0.0 | 74.6 | 74.6 | 0.0 |
| 2 | A41 Oxford Rd, S of A41 junction | 7 | 97 | 12839 | 7 | 97 | 12896 | 0.4 | 73.7 | 73.7 | 0.0 |
| 3 | Vendee Drive, W of A41 junction | 7 | 97 | 42642 | 7 | 97 | 43538 | 2.1 | 78.9 | 79.0 | 0.1 |
| 4 | A41, N of Pingle Drive | 7 | 97 | 8927 | 7 | 97 | 9324 | 4.4 | 72.1 | 72.3 | 0.2 |
| 5 | Middleton Stoney Rd, W of Kings End | 7 | 81 | 22824 | 7 | 81 | 23475 | 2.8 | 74.8 | 74.9 | 0.1 |

| Himley Village | | Assessment of $L_{A10}$ 18-hour Basic Noise Levels at 10m from Road | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Base Year 2031 | | | 2031 + Development | | | | | | |
| Road | | % HGV | Speed kph | Flow | % HGV | Speed kph | Flow | % Flow Change | Base Year | Base Year + Development | Change |
| 6 | Middleton Stoney Rd, W of Kings End | 7 | 81 | 10860 | 7 | 81 | 11206 | 3.2 | 71.6 | 71.7 | 0.1 |
| 7 | Middleton Stoney Rd, W of Howes Lane | 7 | 81 | 5936 | 7 | 81 | 8596 | 44.8 | 69.0 | 70.6 | 1.6 |
| 8 | Howes Lane, N of Middleton Stoney Rd | 7 | 81 | 11622 | 7 | 81 | 10993 | -5.4 | 71.9 | 71.6 | -0.2 |
| 9 | Howes Lane, E of Shakespeare Drive | 7 | 81 | 11504 | 7 | 81 | 11745 | 2.1 | 71.8 | 71.9 | 0.1 |
| 10 | Lords Lane, E of Bucknell Road | 7 | 81 | 14316 | 7 | 81 | 13702 | -4.3 | 72.8 | 72.6 | -0.2 |
| 11 | Lords Lane, W of Banbury Road | 7 | 81 | 14480 | 7 | 81 | 13678 | -5.5 | 72.8 | 72.6 | -0.2 |
| 12 | Bucknell Road, N of Lords Lane | 7 | 48 | 3523 | 7 | 48 | 2969 | -15.7 | 62.9 | 62.1 | -0.7 |
| 13 | Bucknell Road, S of Lords Lane | 7 | 48 | 7404 | 7 | 48 | 7792 | 5.2 | 66.1 | 66.3 | 0.2 |
| 14 | Banbury Road, N of Lords Lane | 7 | 48 | 16755 | 7 | 48 | 17636 | 5.3 | 69.7 | 69.9 | 0.2 |
| 15 | A4095 E of Banbury Road | 7 | 81 | 21827 | 7 | 81 | 22043 | 1.0 | 74.6 | 74.7 | 0.0 |
| 16 | Banbury Road, S of A4095 | 7 | 48 | 8656 | 7 | 48 | 9485 | 9.6 | 66.8 | 67.2 | 0.4 |
| 17 | Buckingham Road, S of Skimmingdish Lane | 7 | 48 | 12834 | 7 | 48 | 13761 | 7.2 | 68.5 | 68.8 | 0.3 |
| 18 | Queens Avenue, S of Bucknell Road | 7 | 48 | 20999 | 7 | 48 | 21567 | 2.7 | 70.6 | 70.8 | 0.1 |
| 19 | A41 E of A41 Oxford Road | 7 | 48 | 35546 | 7 | 48 | 36287 | 2.1 | 72.9 | 73.0 | 0.1 |
| 20 | A4421 Neunkirchen Way | 7 | 48 | 19363 | 7 | 48 | 19881 | 2.7 | 70.3 | 70.4 | 0.1 |
| 21 | A41, E of London Road roundabout | 7 | 48 | 18412 | 7 | 48 | 18590 | 1.0 | 70.1 | 70.1 | 0.0 |
| 22 | A4421, E of Skimmingdish Lane | 7 | 48 | 23556 | 7 | 48 | 24231 | 2.9 | 71.1 | 71.3 | 0.1 |
| 23 | Shakespeare Drive, S of Howes Lane | 7 | 48 | 1140 | 7 | 48 | 1517 | 33.0 | 58.0 | 59.2 | 1.2 |

| Himley Village | | Assessment of $L_{A10}$ 18-hour Basic Noise Levels at 10m from Road | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Road | | Base Year 2031 | | | 2031 + Development | | | % Flow Change | | | |
| | | % HGV | Speed kph | Flow | % HGV | Speed kph | Flow | | Base Year | Base Year + Development | Change |
| 24 | M40 J10 northbound off slip road | 15 | 97 | 6555 | 15 | 97 | 7212 | 10.0 | 71.9 | 72.3 | 0.4 |
| 25 | Ardley Road (E of B430) | 7 | 97 | 4581 | 7 | 97 | 4785 | 4.4 | 69.2 | 69.4 | 0.2 |
| 26 | M40 J10 southbound on slip road (from A43) | 15 | 97 | 4116 | 15 | 97 | 4150 | 0.8 | 69.9 | 69.9 | 0.0 |
| 27 | B430 M40 over bridge | 7 | 97 | 25335 | 7 | 97 | 25651 | 1.2 | 76.6 | 76.7 | 0.1 |
| 28 | A4095 N of Chesterton | 7 | 81 | 10492 | 7 | 81 | 10755 | 2.5 | 71.4 | 71.5 | 0.1 |
| 29 | Shakespeare Drive, E of Middleton Stoney Road | 7 | 48 | 9321 | 7 | 48 | 10079 | 8.1 | 67.1 | 67.4 | 0.3 |
| 30 | The Approach, W of Bucknell Road | 7 | 48 | 4643 | 7 | 48 | 5486 | 18.2 | 64.1 | 64.8 | 0.7 |
| 31 | A41 East of Pioneer Road | 7 | 48 | 31107 | 7 | 48 | 31208 | 0.3 | 72.3 | 72.4 | 0.0 |
| 32 | Bicester Road, E of A4421 junction | 7 | 48 | 5118 | 7 | 48 | 5112 | -0.1 | 64.5 | 64.5 | 0.0 |
| 33 | A4421 N of Skimmingdish Lane | 7 | 48 | 17492 | 7 | 48 | 17787 | 1.7 | 69.8 | 69.9 | 0.1 |
| 34 | Fringford Road, N of Caversfield | 7 | 48 | 1467 | 7 | 48 | 1482 | 1.0 | 59.1 | 59.1 | 0.0 |
| 35 | B4100 Banbury Road, N of Bainton Road | 7 | 97 | 15094 | 7 | 97 | 15325 | 1.5 | 74.4 | 74.5 | 0.1 |
| 36 | Ardley Road, N of Bucknell | 7 | 97 | 4510 | 7 | 97 | 4732 | 4.9 | 69.2 | 69.4 | 0.2 |
| 37 | Middleton Road, W of Bucknell | 7 | 97 | 317 | 7 | 97 | 1339 | 322.5 | 57.6 | 63.9 | 6.3 |
| 38 | B4030 Middleton Stoney Road, NW of NWB | 7 | 97 | 5952 | 7 | 97 | 6825 | 14.7 | 70.4 | 71.0 | 0.6 |
| 39 | Green Lane, W of Chesterton | 7 | 97 | 5992 | 7 | 97 | 6078 | 1.4 | 70.4 | 70.4 | 0.1 |
| 40 | Wendlebury Road, E of M40 | 7 | 97 | 3600 | 7 | 97 | 3684 | 2.3 | 68.2 | 68.3 | 0.1 |
| 41 | M40 | 15 | 113 | 77269 | 15 | 113 | 77269 | 15 | 83.8 | 83.8 | 0.0 |

Table 10.4.3: Cumulative Operational Development Traffic Noise Assessment (Long Term Assessment)

| Himley Village | | Assessment of $L_{A10}$ 18-hour Basic Noise Levels at 10m from Road | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Road | | Base Year 2031 | | | 2046 + Development | | | % Flow Change | | | |
| | | % HGV | Speed kph | Flow | % HGV | Speed kph | Flow | | 2031 | 2046 + Development | Change |
| 1 | A41 northbound, N of M40 J9 | 7 | 97 | 15774 | 7 | 97 | 18069 | 14.6 | 74.6 | 75.2 | 0.6 |
| 2 | A41 Oxford Rd, S of A41 junction | 7 | 97 | 12839 | 7 | 97 | 14770 | 15.0 | 73.7 | 74.3 | 0.6 |
| 3 | Vendee Drive, W of A41 junction | 7 | 97 | 42642 | 7 | 97 | 49763 | 16.7 | 78.9 | 79.6 | 0.7 |
| 4 | A41, N of Pingle Drive | 7 | 97 | 8927 | 7 | 97 | 10627 | 19.0 | 72.1 | 72.9 | 0.8 |
| 5 | Middleton Stoney Rd, W of Kings End | 7 | 81 | 22824 | 7 | 81 | 26807 | 17.4 | 74.8 | 75.5 | 0.7 |
| 6 | Middleton Stoney Rd, W of Kings End | 7 | 81 | 10860 | 7 | 81 | 12792 | 17.8 | 71.6 | 72.3 | 0.7 |
| 7 | Middleton Stoney Rd, W of Howes Lane | 7 | 81 | 5936 | 7 | 81 | 9463 | 59.4 | 69.0 | 71.0 | 2.0 |
| 8 | Howes Lane, N of Middleton Stoney Rd | 7 | 81 | 11622 | 7 | 81 | 12690 | 9.2 | 71.9 | 72.3 | 0.4 |
| 9 | Howes Lane, E of Shakespeare Drive | 7 | 81 | 11504 | 7 | 81 | 13425 | 16.7 | 71.8 | 72.5 | 0.7 |
| 10 | Lords Lane, E of Bucknell Road | 7 | 81 | 14316 | 7 | 81 | 15792 | 10.3 | 72.8 | 73.2 | 0.4 |
| 11 | Lords Lane, W of Banbury Road | 7 | 81 | 14480 | 7 | 81 | 15792 | 9.1 | 72.8 | 73.2 | 0.4 |
| 12 | Bucknell Road, N of Lords Lane | 7 | 48 | 3523 | 7 | 48 | 3484 | -1.1 | 62.9 | 62.8 | 0.0 |
| 13 | Bucknell Road, S of Lords Lane | 7 | 48 | 7404 | 7 | 48 | 8872 | 19.8 | 66.1 | 66.9 | 0.8 |
| 14 | Banbury Road, N of Lords Lane | 7 | 48 | 16755 | 7 | 48 | 20083 | 19.9 | 69.7 | 70.4 | 0.8 |
| 15 | A4095 E of Banbury Road | 7 | 81 | 21827 | 7 | 81 | 25230 | 15.6 | 74.6 | 75.2 | 0.6 |
| 16 | Banbury Road, S of A4095 | 7 | 48 | 8656 | 7 | 48 | 10749 | 24.2 | 66.8 | 67.7 | 0.9 |
| 17 | Buckingham Road, S of Skimmingdish Lane | 7 | 48 | 12834 | 7 | 48 | 15635 | 21.8 | 68.5 | 69.4 | 0.9 |
| 18 | Queens Avenue, S of Bucknell Road | 7 | 48 | 20999 | 7 | 48 | 24633 | 17.3 | 70.6 | 71.3 | 0.7 |
| 19 | A41 E of A41 Oxford Road | 7 | 48 | 35546 | 7 | 48 | 41477 | 16.7 | 72.9 | 73.6 | 0.7 |
| 20 | A4421 Neunkirchen Way | 7 | 48 | 19363 | 7 | 48 | 22708 | 17.3 | 70.3 | 71.0 | 0.7 |

| Himley Village | | Assessment of $L_{A10}$ 18-hour Basic Noise Levels at 10m from Road | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Road | | Base Year 2031 | | | 2046 + Development | | | % Flow Change | | | |
| | | % HGV | Speed kph | Flow | % HGV | Speed kph | Flow | | 2031 | 2046 + Development | Change |
| 21 | A41, E of London Road roundabout | 7 | 48 | 18412 | 7 | 48 | 21279 | 15.6 | 70.1 | 70.7 | 0.6 |
| 22 | A4421, E of Skimmingdish Lane | 7 | 48 | 23556 | 7 | 48 | 27670 | 17.5 | 71.1 | 71.8 | 0.7 |
| 23 | Shakespeare Drive, S of Howes Lane | 7 | 48 | 1140 | 7 | 48 | 1683 | 47.6 | 58.0 | 59.7 | 1.7 |
| 24 | M40 J10 northbound off slip road | 15 | 97 | 6555 | 15 | 97 | 8169 | 24.6 | 71.9 | 72.9 | 1.0 |
| 25 | Ardley Road (E of B430) | 7 | 97 | 4581 | 7 | 97 | 5454 | 19.0 | 69.2 | 70.0 | 0.8 |
| 26 | M40 J10 southbound on slip road (from A43) | 15 | 97 | 4116 | 15 | 97 | 4751 | 15.4 | 69.9 | 70.5 | 0.6 |
| 27 | B430 M40 over bridge | 7 | 97 | 25335 | 7 | 97 | 29350 | 15.8 | 76.6 | 77.3 | 0.6 |
| 28 | A4095 N of Chesterton | 7 | 81 | 10492 | 7 | 81 | 12287 | 17.1 | 71.4 | 72.1 | 0.7 |
| 29 | Shakespeare Drive, E of Middleton Stoney Road | 7 | 48 | 9321 | 7 | 48 | 11440 | 22.7 | 67.1 | 68.0 | 0.9 |
| 30 | The Approach, W of Bucknell Road | 7 | 48 | 4643 | 7 | 48 | 6164 | 32.8 | 64.1 | 65.3 | 1.2 |
| 31 | A41 East of Pioneer Road | 7 | 48 | 31107 | 7 | 48 | 35750 | 14.9 | 72.3 | 72.9 | 0.6 |
| 32 | Bicester Road, E of A4421 junction | 7 | 48 | 5118 | 7 | 48 | 5859 | 14.5 | 64.5 | 65.1 | 0.6 |
| 33 | A4421 N of Skimmingdish Lane | 7 | 48 | 17492 | 7 | 48 | 20341 | 16.3 | 69.8 | 70.5 | 0.7 |
| 34 | Fringford Road, N of Caversfield | 7 | 48 | 1467 | 7 | 48 | 1696 | 15.6 | 59.1 | 59.7 | 0.6 |
| 35 | B4100 Banbury Road, N of Bainton Road | 7 | 97 | 15094 | 7 | 97 | 17529 | 16.1 | 74.4 | 75.0 | 0.6 |
| 36 | Ardley Road, N of Bucknell | 7 | 97 | 4510 | 7 | 97 | 5391 | 19.5 | 69.2 | 69.9 | 0.8 |
| 37 | Middleton Road, W of Bucknell | 7 | 97 | 317 | 7 | 97 | 1386 | 337.1 | 57.6 | 64.0 | 6.4 |
| 38 | B4030 Middleton Stoney Road, NW of NWB | 7 | 97 | 5952 | 7 | 97 | 7694 | 29.3 | 70.4 | 71.5 | 1.1 |
| 39 | Green Lane, W of Chesterton | 7 | 97 | 5992 | 7 | 97 | 6953 | 16.0 | 70.4 | 71.0 | 0.6 |

| Himley Village | | Assessment of $L_{A10}$ 18-hour Basic Noise Levels at 10m from Road | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Road | | Base Year 2031 | | | 2046 + Development | | | % Flow Change | | | |
| | | % HGV | Speed kph | Flow | % HGV | Speed kph | Flow | | 2031 | 2046 + Development | Change |
| 40 | Wendlebury Road, E of M40 | 7 | 97 | 3600 | 7 | 97 | 4209 | 16.9 | 68.2 | 68.9 | 0.7 |
| 41 | M40 | 15 | 113 | 77269 | 15 | 113 | 77269 | 17.8 | 83.8 | 84.5 | 0.7 |

# APPENDIX 11.1
# NW BICESTER MASTERPLAN WATER CYCLE STUDY

# NW Bicester Masterplan

## Water Cycle Study

### Detailed Report

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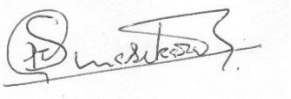
# A2Dominion

# NW Bicester Masterplan

## Water Cycle Study

## Detailed Report

| | | |
|---|---|---|
| **Author** | Dan Vogtlin |  |
| **Checker** | Renuka Gunasekara |  |
| **Approver** | Philip Harker |  |

| | |
|---|---|
| **Report No** | 5010-UA005241-UU71R-01 |
| **Date** | March 2014 |

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# GLOSSARY AND KEY TERMS

| Acronym | Term |
|---|---|
| Amm. N | Ammoniacal Nitrogen |
| AMP | Asset Management Period |
| AMR | Annual Monitoring Report |
| AoD | Above Ordnance Datum |
| ASP | Activated Sludge Process |
| BAP/ (L)BAP | (Local) Biodiversity Action Plan |
| BOD | Biochemical Oxygen Demand |
| BRE | Building Research Establishment (Group) |
| BREEAM | BRE Environmental Assessment Method |
| CAMS | Catchment Abstraction Management Strategy |
| CDC | Cherwell District Council |
| CSH | Code for Sustainable Homes |
| Defra | Department for Environment, Food and Rural Affairs |
| DSR | Distribution Service Reservoir |
| DWF | Dry Weather Flow |
| DWI | Drinking Water Inspectorate |
| EA | Environment Agency |
| FTFT | Flow to Full Treatment |
| GEP | Good Ecological Potential |
| GWR | Greywater recycling |
| HD | Habitats Directive |
| HMWB | Heavily Modified Water Body |
| l/p/d | Litres per Person per Day |
| MBR | Membrane Bioreactor |
| NE | Natural England |
| NWB | North West Bicester |
| OFWAT | The Water Services Regulation Authority |
| ORS | Old Red Sandstone |
| P | Phosphorous |
| PCC | Per Capita Consumption |
| PE | Population Equivalent |
| PPS | Planning Policy Statement |
| PR09/ 14 | Price Review 2009/ 2014 |
| PZ | Planning Zone |
| RBMP | River Basin Management Plan |
| RQP | River Quality Planning (Tool) |
| RSPB | Royal Society for the Protection of Birds |
| RWH | Rainwater Harvesting |
| SPS | Sewage Pumping Station |
| SRP | Soluble Reactive Phosphorus |
| SSSI | Site of Special Scientific Interest |
| SuDS | Sustainable Drainage Systems |
| TWUL | Thames Water Utilities Ltd |
| UKTAG | United Kingdom Technical Advisory Group |
| WCS | Water Cycle Study |
| WFD | Water Framework Directive |
| WRMP | Water Resource Management Plan |
| WRZ | Water Resource Zone |
| WwTW | Wastewater Treatment Works |

# 1 INTRODUCTION AND OVERVIEW

Hyder Consulting Limited were appointed by A2Dominion in May 2013 to produce a Detailed Water Cycle Strategy (WCS) for NW Bicester.

The masterplan and related documents set out spatial vision to provide up to 6000 new homes at NW Bicester. The Water Cycle Strategy sets out the analysis, assessment and justification for the approach to the delivery of key water related infrastructure.

## 1.1 Development context

NW Bicester is being promoted as a site for up to 6000 new homes, after previously being identified as an Eco-town location within the Planning Policy Statement 1 supplement, entitled Eco-Towns A Supplement to Planning Policy Statement 1 (July 2009) (PPS 1 Supplement).

In addition, the development proposal includes non-residential areas comprising commercial floorspace, leisure facilities and social and community facilities.

Planning permission was secured for the Exemplar stage of the development in 2012. The Exemplar stage comprises 393 dwellings. Development of this part of the site is anticipated to commence in 2014.

## 1.2 The role of this document

This strategy is one of a number of documents prepared on behalf of A2Dominion in support of the masterplan plan. The Planning Policy Statement: Eco-Towns A Supplement to Planning Policy Statement 1 (July 2009) requires the preparation and submission of a master plan to demonstrate the eco town standards, as set out in the PPS1 supplement, will be addressed.

The master plan will therefore provide the context for the formulation and preparation of subsequent planning applications. It is open to the Council to adopt the master plan for development control purposes.

The purpose of the WCS is to assess the impact that the proposed development will have on water demand, demonstrate that the development will not result in a deterioration in the status of any surface waters or ground-waters affected by the NW Bicester development, identify the proposed water and wastewater infrastructure improvements required, and set out proposed measures for improving water quality and avoiding surface water flooding from surface water, groundwater and local watercourses.

## 1.3 Planning policy

NW Bicester (NWB) is identified in the supplement to PPS1 entitled 'The Planning Policy Statement: Eco-Towns A Supplement to Planning Policy Statement 1' (July 2009) as one of four locations for an Eco Town. The principle of the development is supported by Cherwell District Council ('the Council') and the land to the north west of Bicester ('the Site') is identified in the emerging Local Plan as the area within which a development following eco-town principles and the standards in PPS1 Supplement could be developed.

Policy ET 17.5 of the PPS1 Supplement states that the development should aspire towards water neutrality. The current definition of water neutrality accepted by the EA[1] is that:

"For every new development, total water use across the wider area after the development must be equal to or less than total water use across the wider area before the development".

It is anticipated that the current Government will cancel the current PPS Supplement in due course. Notwithstanding, the requirements of the Supplement to PPS1 will be carried over by Cherwell (subject to review and amendments as necessary) into the Local Plan. The Council has already set out its policy position in respect of NWB in the emerging Local Plan and granted planning permission for the Exemplar Phase of NWB for 393 new homes, local facilities and land for a primary school.

## 1.4 Stakeholders

The development of the Scoping and Outline WCS, and this Detailed WCS, has involved consultation with the following stakeholders:

- Thames Water Utilities (TWU);
- Environment Agency (EA);
- Natural England (NE);
- Cherwell District Council (CDC); and
- Oxfordshire County Council.

## 1.5 Previous study

Hyder produced a Scoping and Outline WCS in April 2011, for the initial 393 home Exemplar site and 5,000 additional homes, which concluded the following:

### 1.5.1 Water resources and supply

- The area is considered to be water-stressed, with the statutory water undertaker for the area – TWUL, predicting supply demand deficits in the area from 2014 onwards, and requiring additional resource development in the future to address this deficit;
- It is expected that no new surface water abstraction would be granted for the development, although existing licences in the area may potentially be upgraded, subject to further investigation;
- The potential of providing an onsite water supply for the development from groundwater sources should be considered further; and
- Water efficiency measures in new properties (and potentially retrofitted in the surrounding area) should be explored further for the development, as should local water reuse, to allow the development to aspire towards water neutrality.

### 1.5.2 Wastewater collection, treatment and discharge

- The receiving watercourses are at risk of failing Water Framework Directive (WFD) standards due to phosphate and nitrate concentrations, which could potentially be exacerbated by further effluent discharge
- Foul water infrastructure is potentially at capacity and may require improvement – a range of feasible options were identified including:

- Pump foul water from the development to the existing Bicester Wastewater Treatment Works (WwTW) operated by TWUL, which would require upgraded to process/hydraulic capacity;
- Construct a new WwTW on site to locally treat and discharge foul water to the Town Brook (River Bure), or locally to new constructed wetlands (for potential abstraction and reuse);
- Reduce the impact on the new or existing WwTW by the separation of greywater (from showers, baths and wash/ hand basins) in to a separate sewerage system, to be treated on the development for reuse; or
- Incorporate property level greywater recycling (GWR) systems in to the development to reduce the impact on the new or existing WwTW, and provide a local source of non-potable water.

### 1.5.3 Surface water

- The widespread use of Sustainable Drainage Systems (SuDS) and water harvesting should be explored to provide sustainable storm water management, and create a sustainable resource from rainfall; and
- The use of SuDS would allow the creation of new wildlife spaces incorporating wetlands, ponds and a variety of vegetation, creating valuable open amenity areas whilst enhancing the local water environment.

## 1.6 Detailed WCS objectives

The objectives of this Detailed WCS can be summarised as follows:

- Investigate the conclusions and recommendations from the above, in light of emerging development plans, updated stakeholder data and industry developments;
- Assess potential solutions to reduce potable water demand and make alternative resources available, which could be used to move the development site towards water neutrality;
- Work closely with the stakeholders and service providers to assess the options for wastewater treatment, and confirm the necessary water quality standards to protect the receiving water environment and comply with legislation;
- Identify possibilities to link the management of surface water drainage with the above solutions, and the amenity and ecological benefits that can be realised from such strategies;
- Assess to what extent the above solutions would be viable and sustainable when considered in conjunction with other development in the Bicester area; and
- Provide transparent and evidence based advice to A2Dominion and CDC; representing the stakeholders' views as to the feasibility, viability and sustainability of the potential water and wastewater solutions available, to support the development masterplan and allow robust decision making through the planning process.

Notably, Hyder are also preparing a Surface Water Drainage Strategy in parallel to this Detailed WCS. For this reason, this Detailed WCS scope only includes flooding and surface water considerations where a potential link exists with water supply, and wastewater collection and treatment. The details of Surface Water Drainage Strategy are presented within Appendix E of the Flood Risk Assessment Report prepared by Hyder for the NW Bicester Development and therefore these details are not repeated here.

## 1.7 Water infrastructure delivery

### 1.7.1 Conventional funding

Conventional provision of water supply, and wastewater collection/ treatment infrastructure in the Bicester area is via the statutory water/ wastewater undertaker (TWUL), under the provisions of the Water Industry Act 1991.

TWUL have a duty to supply potable water to customers under Section 52 of the Act, and are hence obliged to connect developments to the network once planning permission has been received. The EA use the provisions of the Act, and their powers under the Water Resources Act 1991 to regulate how much water TWUL can abstract from the environment, by granting abstraction licenses.

In addition, TWUL have a duty to provide and maintain a system of public sewers under Section 94 of the Water Industry Act. The EA use the provisions of the Water Resources Act 1991, and Urban Wastewater Treatment Directive, to control the quality and quantity of effluent discharged from WwTW.

The investment plans of TWUL are based on a five-year cycle, known as Asset Management Periods (AMPs). In general, funding for the maintenance of the existing supply demand balance and the potable water network (including the provision of new strategic infrastructure) comes from investment through the business plan process, whereby the water regulator (Ofwat) sets agreed price increases in customer bills. Ofwat regulate the levels of expenditure of water companies to a level that they see as being affordable by their existing customers.

Similarly, wastewater treatment improvements, maintenance of the existing sewerage network, and the provision of regionally important sewerage schemes, are agreed by Ofwat and funded through customer bills as above.

The current AMP is AMP5 (2010–2015), and TWUL will be currently working to deliver resource development, wastewater treatment improvements and infrastructure maintenance which they identified in their Final Business Plan (agreed by Ofwat) during the Price Review period in 2009 (PR09).

Figure 1-1 illustrates the AMP5 process to 2015, which may dictate the constraints on infrastructure planning and funding, and thereby influence the capacity available for the proposed development in the short term.

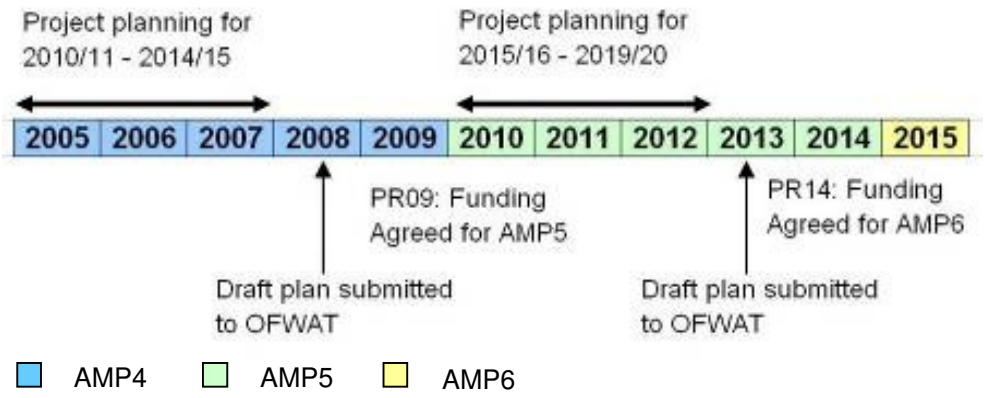


**Figure 1-1 Conventional water company planning and funding cycle**

*Adapted from Rye Meads Water Cycle Strategy Scoping Report; EA, August 2007*

TWUL submitted their business plan to Ofwat in December 2013, for the price review in 2014 (PR14), which will detail their planned investment for AMP6.

TWUL have limited powers under the Water Industry Act 1991 to prevent connection of new dwellings ahead of the required infrastructure upgrades, and therefore rely on the planning system (through appropriate planning conditions) to ensure that development does not lead to an unacceptable risk of flooding, or pollution of watercourses.

Where new water supply or sewerage network (pipes, pumping stations or service reservoirs) is required to serve the development site, developers may requisition this infrastructure in accordance with S41 and S98 of the Water Industry Act 1991.

The difference between the costs of infrastructure upgrades (including the provision of any off-site network), and the predicted revenue from the new customers, can be passed onto developers from water companies using Requisitioning Agreements. The amount charged is referred to as the 'relevant deficit', and can be paid over a 12 year period, or one lump sum discounted to a net present value. TWUL also offer, at their discretion, an option of a commercial commuted sum in addition to these two regulatory options.

In addition, TWUL charge every developer a fixed regulated 'infrastructure charge' to contribute towards any improvements required to the existing water supply and sewerage network in to which their new infrastructure will connect.

### 1.7.2 Inset arrangements

Section 6 of the Water Industry Act 1991 (as amended) allows for new limited companies to be appointed as either water or sewerage undertakers for an area. These inset appointees can be appointed providing one of the following criteria are met:

- The area does not contain any premises that receive services from an appointed water or sewerage company (greenfield sites tend to meet this 'unserved' criterion – however consideration needs to be made for existing connections to the farm buildings across the site;
- A customer uses (or is likely to use) in excess of 50 Ml of water a year and wishes to change their supplier; or
- The existing incumbent appointed undertaker consents to transfer some of its existing area to the new appointee.

Once appointed, an inset water or sewerage company has the same serviceability, quality, data management and financial responsibilities as a statutory water or sewerage undertaker as defined under the Water Industry Act. For Ofwat to grant this appointment, the inset company must demonstrate that they have the ability to carry out and finance the operation.

Additionally, for water supply inset appointments, the Drinking Water Inspectorate (DWI) undertake a competency assessment of the new supplier which appraises their company procedures, and their ability to manage any supply risks in the area.

Since 2007 there have been five new inset appointments granted for either water and sewerage, or sewerage only companies. Four of these appointments met the unserved criterion, whilst the fifth was by incumbent consent. Once an inset company has been successfully appointed a water/ sewerage area, they are then able to apply for a variation of this area (again under the Section 6 of the Water Industry Act). These areas do not have to be geographically linked – which then allows these inset companies to competitively pursue additional development areas across England and Wales.

Section 7 of the Water Industry Act places a duty on Ofwat/Defra to ensure that a water and sewerage undertaker serves all parts of England and Wales, and allows them to vary existing appointment areas to ensure this remains the case. This therefore provides reassurance that a development will not be left unserved if the inset company leaves the market.

Additionally, Sections 23 to 26 of the Water Industry Act prohibit an appointed company being wound up voluntarily, or an administration order being made in relation to the company. If a winding up application is made in relation to an appointed company this cannot be granted – instead the company enters in to a special administration order which allows transfer of any supplied areas to another appointed company as a going concern, hence protecting customers' services.

# 2 WATER ENVIRONMENT

## 2.1 Potential impacts

The water environment in and adjacent to areas of development (and in downstream river reaches) has the potential to be detrimentally impacted by the following activities:

- Increased **abstraction of water**, from rivers and the aquifers which support them, to supply the increasing population, potentially leading to:
  - Reduced volumetric flows in rivers, particularly during summer months, which decreases the capability of the watercourse to dilute the pollutants – increasing the risk that aquatic life will be affected, and the risk of non-compliance with statutory water quality targets;
  - Decreased water levels in watercourses – resulting in detriment to bankside habitats or species which depend on these levels; and
  - Decreased water levels and flood frequencies in adjacent sites where the sensitive habitats and protected species are dependent on these factors, such as reedbeds, fens, and ditches through floodplain grazing marshes;
- Increased volumes of urban **surface water run-off** due to an increase in impermeable area in development locations, potentially leading to:
  - Increased conveyance of pollutants including hydrocarbons, detergents and suspended solids in to watercourses (or aquifers via soakaways) – resulting in detrimental impacts to aquatic life and non-compliance with statutory water quality targets; and
  - Increased flood risk to people and property due to deep and/ or fast moving surface water flooding.
- Decreased capacity in the existing **sewerage network** due to the increasing population, leading to:
  - Increased chance of spills from surcharging manholes - resulting in overland flow of raw wastewater, with the final receptor being the watercourse or aquifer, and an increased risk of foul water flooding to people and property; and
  - Increased chance of spills of screened wastewater to receiving watercourses from combined sewer overflows on sewerage networks, and emergency overflows at sewage pumping stations (SPS) – resulting in shock pollutant loads and non-compliance with statutory water quality targets;
- Increased consented discharges of treated **wastewater effluent** from WwTW due to population growth, potentially leading to:
  - Increased suspended solids, which can transfer pollutants and pathogens to river beds as they settle;
  - Increased bio-chemical oxygen demand (BOD) from aerobic biological organisms in the water, resulting in less dissolved oxygen for aquatic life to utilise; and
  - Increased discharges of ammoniacal nitrogen (Amm. N – which is toxic to aquatic organisms) and phosphorus (P) leading to an increase in concentrations of nitrates and phosphates – nutrients which can lead to eutrophication and the excessive growth of algae, again restricting the dissolved oxygen available for other aquatic life, and hampering alternative use of the water, such as recreation or water supply.

## 2.2 Receiving water environment

The existing watercourse across the north of the site drain south eastwards, pass under the A4095, and continue through the existing town. This watercourse is in part designated a Main River, and is referred to as the Town Brook at Bicester by the EA (and locally referred to as the River Bure).

Immediately downstream of the A4095, the Town Brook passes through the Bure Park Local Nature Reserve (LNR). This 8.4 ha site was declared of local interest by CDC because of the habitats therein, including grass meadow, young broad-leaved woodland, hedges, scrub and the river itself. The latest information from Natural England (NE)[2] suggests the river feeds a small pond which is home to great crested newts.

Immediately south of the town, the Town Brook joins the Langford Brook. The south of the proposed site is drained via an Ordinary Watercourse referred to as the Pingle Brook, which flows in to the Town Brook just upstream of its confluence with the Langford Brook.

The existing Bicester WwTW, operated by TWUL, discharges to the Langford Brook just south of the town.

4.2 km south of the WwTW, the Langford Brook enters the Wendlebury Meads and Mansmoor Closes Site of Special Scientific Interest (SSSI). According to NE[3], this site consists of a rare traditionally managed unimproved neutral meadow draining to the river, incorporating exceptionally diverse flora with over 160 plant species. Short term flooding from the river is described as a frequent occurrence, and the quantity of flooding, and water quality, will in part be responsible for the diversity of the site. The SSSI site was listed as being in favourable condition in February 2014 by NE.

1.1 km after entering the SSSI boundary, the Langford Brook joins the Oxon Ray, which then continues to flow southwards for 1.2 km before reaching the Otmoor reserve. This Royal Society for the Protection of Birds (RSPB) reserve and SSSI incorporates wet meadows and reedbeds which regularly flood, with many species of nationally uncommon plants and animals supported[4]. The SSSI site includes a complex network of drains, weirs and sluices interacting with the Oxon Ray.

Downstream of Otmoor SSSI, the Oxon Ray flows westwards for 3 km before joining the River Cherwell near Islip.

## 2.3 Water quality in rivers

In addition to the requirement to protect the designated sites above, the stakeholders in the area are required to comply with the European Water Framework Directive (WFD). The EA are the lead authority responsible for compliance with the WFD in England.

The WFD sets out a strategy for protecting and enhancing the quality of groundwater, rivers, lakes, estuaries and coasts. The main objectives of the WFD are to prevent any deterioration in the current ecological status, and bring all water bodies up to 'good status' by 2015, or 2027 at the latest. The quality parameters for the assessment of a river have been set by the UK Technical Advisory Group (UK TAG)[5]. A requirement of the WFD is that a no deterioration policy is adopted for the WFD quality parameters, which could have potential implications for future developments.

Extensive data as to the current ecological classification of the Town Brook, Langford Brook and Oxon Ray is published by the EA in the Thames River Basin Management Plan[6] (RBMP).

The Town Brook is classified as being Heavily Modified, as the channels has undergone significant historical morphological changes due to urbanisation. The WFD requirement for Heavily Modified Water Bodies (HMWB) is to reach good ecological potential (GEP), as opposed to 'good status', however the water quality standards required are consistent, regardless of the designation as HMWB.

Under the WFD, supporting elements are assigned a status using the following system:

| Physio-chemical Elements | Hydromorphology |
|---|---|
| High | |
| Good | Supports Good status |
| Moderate | Does not support Good status |
| Poor | |
| Bad | |

**Table 2-1 WFD: Surface water bodies - system of classification**

These parameters will influence the overall classification of the water bodies – failure to meet Good status for one element will lead to an overall classification of less than Good status. For clarity, the current status of the water bodies (pertinent to this WCS), and the target status for these water bodies, are summarised in Table 2-2 below.

| Water Body Reference | Reach Description | Current Ecological Status (or Potential) 2009 | Target Ecological Status (or Potential) and Date |
|---|---|---|---|
| Town Brook | Town Brook at Bicester | Moderate | Good – 2027 |
| Langford Brook | Bicester to Ray inc. Gagle Brook | Moderate | Good – 2027 |
| Oxon Ray | Upstream A41 to Cherwell inc. Otmoor | Poor | Good – 2027 |

**Table 2-2 WFD: current status and targets**

As discussed in Section 2.1, proposed development has the potential to impact primarily on the following supporting elements which form part of the overall ecological status classification:

- Ammonia, via the discharges of Amm. N;
- Dissolved Oxygen, via discharges of BOD (and excessive uptake of oxygen following nutrient enrichment);
- Phosphate, via discharges of P; and
- Quantity and Dynamics of Flow, via abstractions from rivers and aquifers.

Table 2-3 illustrates how the above elements are currently contributing to the overall classification of ecological potential.

| Water Body Reference | Reach Description | Ammonia | Dissolved Oxygen | Phosphate | Flow |
|---|---|---|---|---|---|
| Town Brook | Town Brook at Bicester | High | Good | Poor | Supports Good |
| Langford Brook | Bicester to Ray inc. Gagle Brook | High | Good | Poor | Supports Good |
| Oxon Ray | Upstream A41 to Cherwell inc. Otmoor | High | Moderate | Poor | Supports Good |

**Table 2-3 WFD: individual components of current ecological status**

The UKTAG guidance suggests that the following concentration standards should be used for the classification of physio-chemical supporting elements in the study area:

| Physio-chemical supporting element | High | Good | Moderate | Poor | Bad |
|---|---|---|---|---|---|
| BOD mg/l (90%ile) | < 4 | < 5 | < 6.5 | < 9 | > 9 |
| Total Ammonia mg/l (90%ile) | < 0.3 | < 0.6 | < 1.1 | < 2.5 | > 2.5 |
| Soluble Reactive Phosphorus mg/l (Annual Average) | < 0.05 | < 0.12 (0.08)* | < 0.25 | < 1 | >1 |

**Table 2-4 WFD: concentration standards for physio-chemical elements**

Additionally, the EA have advised that whilst the target P concentration to achieve Good status is currently 0.12 mg/l, this will be tightened to 0.08 mg/l post 2015.

Phosphate levels are a concern throughout the majority of England. On-going cooperation is required between water companies, the EA and other parties to overcome this issue at a national and regional level.

Whilst the EA is the 'competent body' tasked with implementing the WFD in England, other stakeholders will have an important part to play. The Programmes of Measures included in the RBMPs contain integrated solutions requiring input and action from Natural England, the water companies, local authorities, existing landowners and developers. To achieve the above P targets, diffuse sources must also be targeted for reduction.

* The EA have advised that whilst the target P concentration to achieve Good status is currently 0.12 mg/l, this will be likely tightened to 0.08 mg/l post 2015 (currently subject to consultation).

## 2.4 Water quality modelling

The EA River Quality Planning (RQP) tool (version 2.5) has been used by the EA to inform the water quality aspects of this WCS. The RQP tool uses mass balance Monte Carlo simulations to identify the indicative consent standards that would need to be applied to a new or increased WwTW discharge, and the change in downstream concentrations of physio-chemical elements following a discharge.

The RQP tool was used to calculate the indicative consent standards which would be required to ensure the increased discharges of treated effluent do not cause deterioration in the existing water quality. The physio-chemical standards required to prevent deterioration in current WFD class at the downstream point following the new discharge from a potential on-site WwTW, or an increased discharge from Bicester WwTW, have been calculated. These are discussed further in Section 6.

# 3 WATER RESOURCES

## 3.1 Local water resources

The site is located within the Cherwell, Thame and Wye water resources catchment. In this region the most important factor is ensuring that sufficient flow flows towards the River Thames. A review of the most recent EA Catchment Abstraction Management Strategy[7] (CAMS) for the area identified that:

- No new consumptive surface water licences will be granted at low flows;
- Any new consumptive groundwater licences in direct hydraulic continuity with surface water will be subject to a determined flow at Kingston gauging station; and
- Restrictions will be determined case-by-case based on the nature and scale of the proposed abstraction.

In 2013 Hyder undertook a Groundwater Supply: Feasibility Study[8] to appraise the possibility of utilising local groundwater abstractions to supply the development, and hence reduce reliance on the statutory water undertaker.

This study identified the following:

- The Great Oolite aquifer (a moderately productive fracture flow aquifer comprising alternating sequences of limestones and clays ) underlies the whole site and is in probable hydraulic connection/partial connection to surface water streams;
- The Great Oolite was used for water supply including for Bicester town in the 1930's. Yields stated in records for the Great Oolite in this area are typically between 0.5 to 11 l/s. There appears to have been a decline of the use of these wells to redundancy or lower licenced or unlicensed abstraction rates. This may indicate that the sustainability of higher yields is problematic;
- Superficial deposits were either thin or absent with bedrock strata encountered close to ground level, meaning that the Great Oolite aquifer is vulnerable to pollution from the surface (e.g. spillages, landfill or diffuse pollution);
- The Old Red Sandstone (ORS) aquifer is deep (in excess of 160 m) below the whole region and little data is currently available, although it is thought to have limited permeability and transmissivity;
- The ORS aquifer is overlain by thick mudstones and is therefore not in hydraulic continuity with the shallower aquifer, hence it may be possible to abstract without directly affecting neighbouring abstractions and surface water flows. However, the water could tend to be more brackish than at shallow depths and there could be elevated mineral content of say iron, manganese and trace metals.

The study concluded that:

- It is unlikely the Great Oolite aquifer would be considered a suitable source for new water supply for the NW Bicester Development. Partial supply may be possible, subject to further assessment of water quality, and an assessment of the likely long term water quality with respect to vulnerability to surface spillages; and
- The ORS aquifer may be considered a more suitable source for new water supply for the NW Bicester Development. However, at least two deep boreholes (perhaps up to 400 m deep) would be required, and it is possible that yields would be lower than expected due to the depth of the aquifer (causing closure of fractures), lower than assumed

groundwater levels, or other restrictions to protect neighbouring resources as determined by EA assessment . Water quality is unknown, but it is likely that some treatment (or blending with a bulk supply from TWUL) will be required before potable use.

If new local abstractions were utilised for potable water supply for the NW Bicester Development, connections to the wider TWUL infrastructure network would be required to provide sufficient resilience for customers, regardless of whether the on-site supply was via TWUL or an inset company.

Providing a proportion of the supply from local abstractions would do little to reduce the extent of any off-site resilience works, as it is likely that the connections would be sized to allow full supply from off-site in case of operational outages, contamination or drought.

Therefore, local abstractions would increase the costs and risks of providing a potable water supply to the NW Bicester Development. Given the planned availability of water resources in the surrounding area (see Section 3.2), and the proximity to existing and planned water supply infrastructure (see Section 4.1), local abstraction is not considered to be a preferable option at this time.

The exception to this would be if additional WwTW effluent discharged to local surface waters was subsequently abstracted to provide a proportion of the supply to the NW Bicester development, as this would mitigate impacts on the surface water and groundwater resource availability, and avoid the requirement for constructing deep boreholes with unknown water quality and yield.

## 3.2 Regional water resources

TWUL are responsible for maintaining the public water supply across the study area. Every five years, in conjunction with their business plan submission, TWUL are required to set out their strategic requirements for the following 25 years in a Water Resource Management Plan (WRMP).

Following a period of formal consultation in 2013, TWUL have submitted their draft revised WRMP 2015 – 2040[9] for consideration by Defra, with the aim of it being approved for the start of AMP6.

The WRMP sets out the best value demand management and resource development options which TWUL plan to implement, to prevent the supply demand deficits occurring. This strategy includes allowances for predicted development and population changes, and the impacts of climate change.

The development site and Bicester town lie within their Swindon and Oxfordshire (SWOX) Water Resource Zone (WRZ), as shown in Figure 3-2.

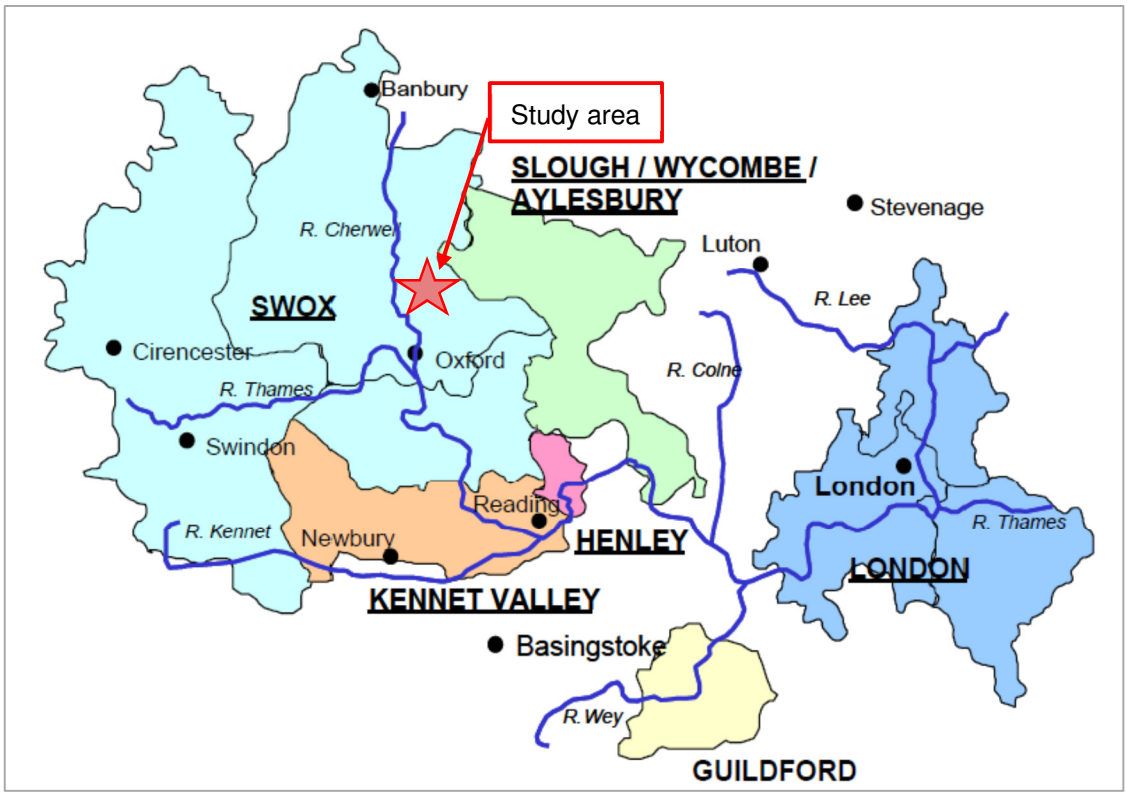


**Figure 3-2 TWUL water resource zones**

*Adapted from TWUL Revised Draft WRMP 2013*

The draft revised WRMP suggests that, for the SWOX WRZ:

- Without further investment, a supply demand deficit would develop in a dry year average scenario from 2023/24 rising to 14.6 Ml/d by 2039/40, and in a critical demand period, a deficit from 2019/20 rising to 33 Ml/d by 2039/40;
- The above baseline deficits are driven by population growth, climate change and requirements to reduce some abstractions for environmental reasons (referred to as sustainability reductions);

In order to prevent the above deficits, TWUL are proposing a programme of measures to reduce demand, including:

- Rolling out metering, to increase meter penetration from 65% of households at the end of AMP6, to 93% of households by the end of AMP10;
- A campaign promoting water efficiency, to build on the Save Water Swindon campaign launched in 2010 ;
- Introduction of revised tariffs to encourage customer behavioural change; and
- A reduction in leakage from customers' supply pipes, made possible due to the increased data and focus on water from the above.

Figure 3-3 shows TWUL's proposed plan for the SWOX WRZ, highlighting how the proposed reduction in demand (distribution input – DI, and target headroom – TH) ensures a surplus is maintained despite planned reductions in available resources (water available for use - WAFU).

The reduction in WAFU shown includes an allowance for the confirmed sustainability reduction requested by the EA at Axford, and likely sustainability reductions at Ogbourne and Childrey Warren.

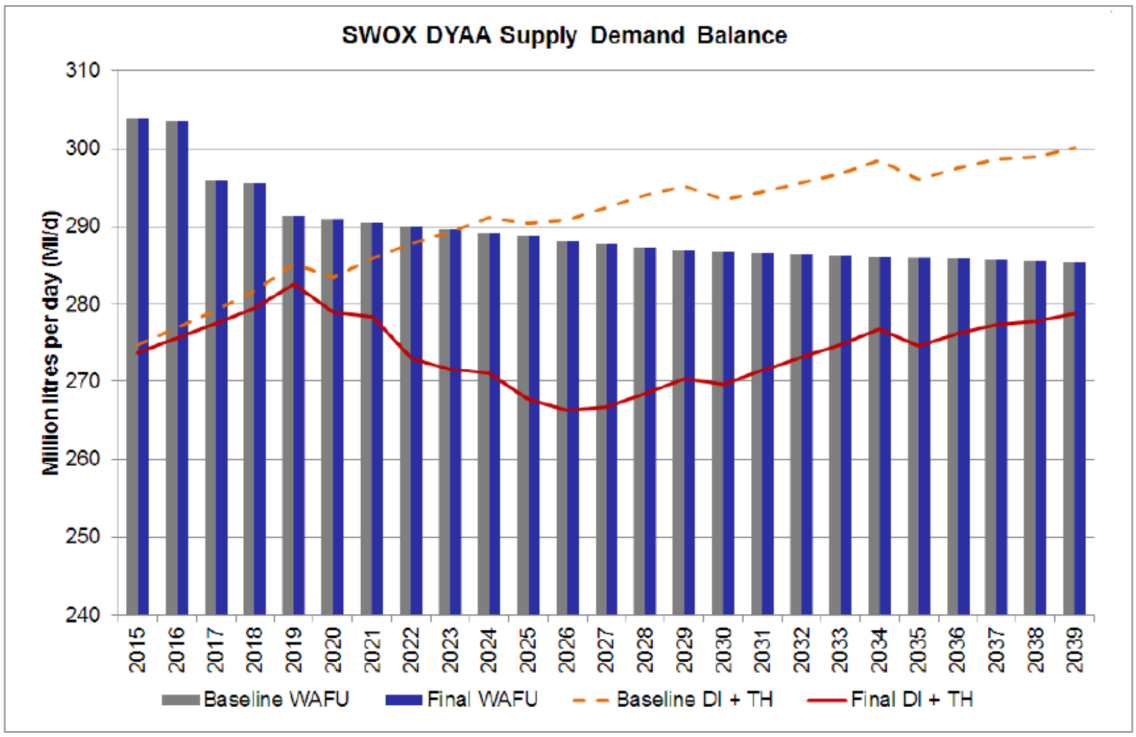


**Figure 3-3 SWOX WRZ Dry Year Average Planned Supply and Demand**

*TWUL Revised Draft WRMP 2013*

Notably, the above situation represents an improvement since the Scoping and Outline WCS; which had reported that the TWUL draft WRMP for 2010 to 2035 was predicting deficits occurring from 2014 onwards. This has since been resolved by TWUL implementing groundwater resource development schemes to bolster the resilience of the SWOX WRZ throughout AMP5.

It can therefore be concluded that TWUL have the ability to provide adequate supply of potable water to the proposed development, despite increasing population, and decreasing availability of water resources. The development is therefore considered in compliance with CDC Policy ESD 8, regarding the adequacy of water resources.

In addition, it should be noted that SWOX WRZ consists of three interconnected Planning Zones (PZ); Swindon, South Oxfordshire and North Oxfordshire, of which Bicester is located in the latter. TWUL advised this study in 2013[10] that the potential deficits in the SWOX WRZ related primarily to development in the Swindon PZ, rather than the North Oxfordshire PZ, which was not predicted to develop a deficit. This further reinforces the conclusion that adequate water resources are available to supply the proposed development.

# 4 WATER SUPPLY INFRASTRUCTURE

## 4.1 Existing water supply infrastructure

TWUL supply the SWOX WRZ primarily from abstraction from the River Thames and its tributaries, stored in reservoirs, as shown in Figure 4-4.


**Figure 4-4 TWUL water resource schematic**
*Adapted from TWUL Revised Draft WRMP 2013*

Hyder undertook consultation with TWUL in 2013 to ascertain the capacity of the existing water supply infrastructure.

According to TWUL, the majority of the supply for Bicester is sourced from near Oxford. Raw water is abstracted from the River Thames to the west of Oxford, stored and treated at Farmoor, and then transmitted northwards with the assistance of a large pumping station near the A44 to the west of Bicester. Potable water is stored in a Distribution Service Reservoir (DSR) to the north west of Bicester, and the town is then supplied from here via a 450 mm main which runs through the NW Bicester development site along the existing bridleway.

## 4.2 Proposed water supply infrastructure

TWUL advise that they have recently upgraded the capacity of the pumping station, and the main from the DSR to Bicester. Additionally, TWUL completed the Bicester ring main in 2012,

which allows increased resilience in supplying the town, and is designed to cater for the next 40 years of development as assessed by TWUL.

TWUL also advised that the part of the network with the lowest capacity for development is the transfer main from the pumping station to the DSR, however this can be upgraded through the normal funding cycle and hence should not be considered a constraint to the proposed development.

It is estimated that the requisition, design, construction and commissioning of extensions to the strategic water network can take up to three years following the receipt of a developer requisition. However, given the proximity of the development site to the existing 450 mm main, it should be relatively simple and cost effective for TWUL to provide a supply to the development, once requisitioned by either the developer or a potential inset company.

Providing an agreement is reached soon, it is not considered that the provision of this infrastructure would significantly constrain the construction of the development from 2014/15 onwards.

Additionally, TWUL advise a five metre zone from the existing 450 mm main should be protected from development, to avoid the requirement to divert the main, and ensure adequate access is maintained for maintenance and further connections. The current NW Bicester masterplan adheres to this advice, by proposing a green area over the route of the existing bridleway through the development.

# 5 Potable water demand and supply

This Section further explores the proposed new potable water demand from the development, and the alternative methods to reduce the demand on the existing TWUL network - and hence move the development towards water neutrality to assist in avoiding the above mentioned supply demand deficits.

## 5.1 Existing potable water demand

According to the draft revised WRMP, TWUL estimate that the average per capita consumption (PCC) of potable water in the SWOX WRZ in 2011/12 was 156 litres per person per day (l/p/d) for properties without a meter, and 129 l/p/d for metered properties.

TWUL estimate that without any intervention, average PCC would remain relatively stable to 2039/40, as increasing demand would be offset by the increased penetration of meters. However, following the implementation of the demand management measures (see Section 3.1), TWUL estimate that average PCC across the Thames Valley area will reduce to approximately 129 l/p/d by 2039/40.

## 5.2 Planned potable water demand

Notably in their WRMP forecasts, TWUL have estimated that all new properties achieve an average PCC of 125 l/p/d. This aligns with the Building Regulations Part G requirement that whole building water usage should equate to 125 l/p/d.

In this WCS, it would typically be expected that new development would at least meet the requirements of the Code for Sustainable Homes (CSH) Levels 3/4. This equates to a PCC of 105 l/p/day.

However, the PPS1 Supplement requires that water efficiency equates to 80 l/p/day, in an aspiration to achieve CSH Levels 5/6. The details of how this may be achieved are discussed further in Section 5.5.

Based on the above policies, it can be concluded that the proposed PCC targets for the development are within the estimates used by TWUL for their WRMP – hence the development will not make it more difficult for TWUL to achieve their demand management strategy and ensure a supply demand surplus is maintained. Again, this illustrates compliance with CDC Policy ESD 8.

## 5.3 Estimated new potable water demand

The new residential demand of potable water from the NW Bicester development has been calculated using the following equation:

*New Demand (Ml/d) = [No. of new homes x occupancy rate x PCC (l/p/d)] / 1,000,000*

The occupancy rate of the new dwellings is assumed to remain constant at 2.4, which is consistent with TWUL high level planning estimates for the area.

As discussed in Section 5.2, the PPS1 Supplement requires a PCC rate of 80 l/p/d. For comparison within this WCS, potable water demand has also been calculated using PCC rates of 105 l/p/d and 125 l/p/d. The latter is considered to be the worst case, as it is the minimum

requirement in accordance with the Building Regulations, and similar to the current TWUL estimate for new metered properties.

Additionally, this WCS has estimated potable water demand from the proposed non-domestic properties and community infrastructure.

These estimates only relate to the domestic component of use (i.e. employees using kitchen and bathroom facilities), as any significant volume of water required for industrial processes will be subject to separate financial agreements with the water supplier, and cannot be accurately estimated unless the proposed industrial processes are known.

Based on the proposed business classes and plot areas of the masterplan, it is estimated that the NW Bicester development will provide space for approximately:

- 4,600 jobs, including around 2,000 jobs at the proposed business park, with further provision elsewhere within the local area;
- One secondary school; and
- Up to four primary schools.

Additionally, NW Bicester will include care home provision, extra care at home provision, and hotel provision. This WCS has assumed approximate water usage values for these non-residential uses.

The following potable water usage rate of has been assumed, based on the plumbing Engineering Services Design Guide[11].

| Facility type | Litres per day | Per unit |
|---|---|---|
| School - Nursery and Primary | 15 | Pupil |
| School - Secondary and College | 20 | Pupil |
| Hotel – average | 150 | Room |
| Employment including homeworking, retail, care, factories, warehousing and offices | 45 | Employee |
| Care home | 135 | Bed space |
| Extra care housing | 120 | Bedroom |

**Table 5-5 Potable water demand rates for non-residential development**

For the purposes of this WCS, it is assumed that potable water demand from employment/non-residential areas increases proportionately in line with the build out trajectory of the residential units.

Figure 5-5 illustrates the calculated cumulative new potable water demand from the proposed development. Demand from the residential properties is illustrated at each of the three PCC rates, and total demands including the non-residential components are also shown.

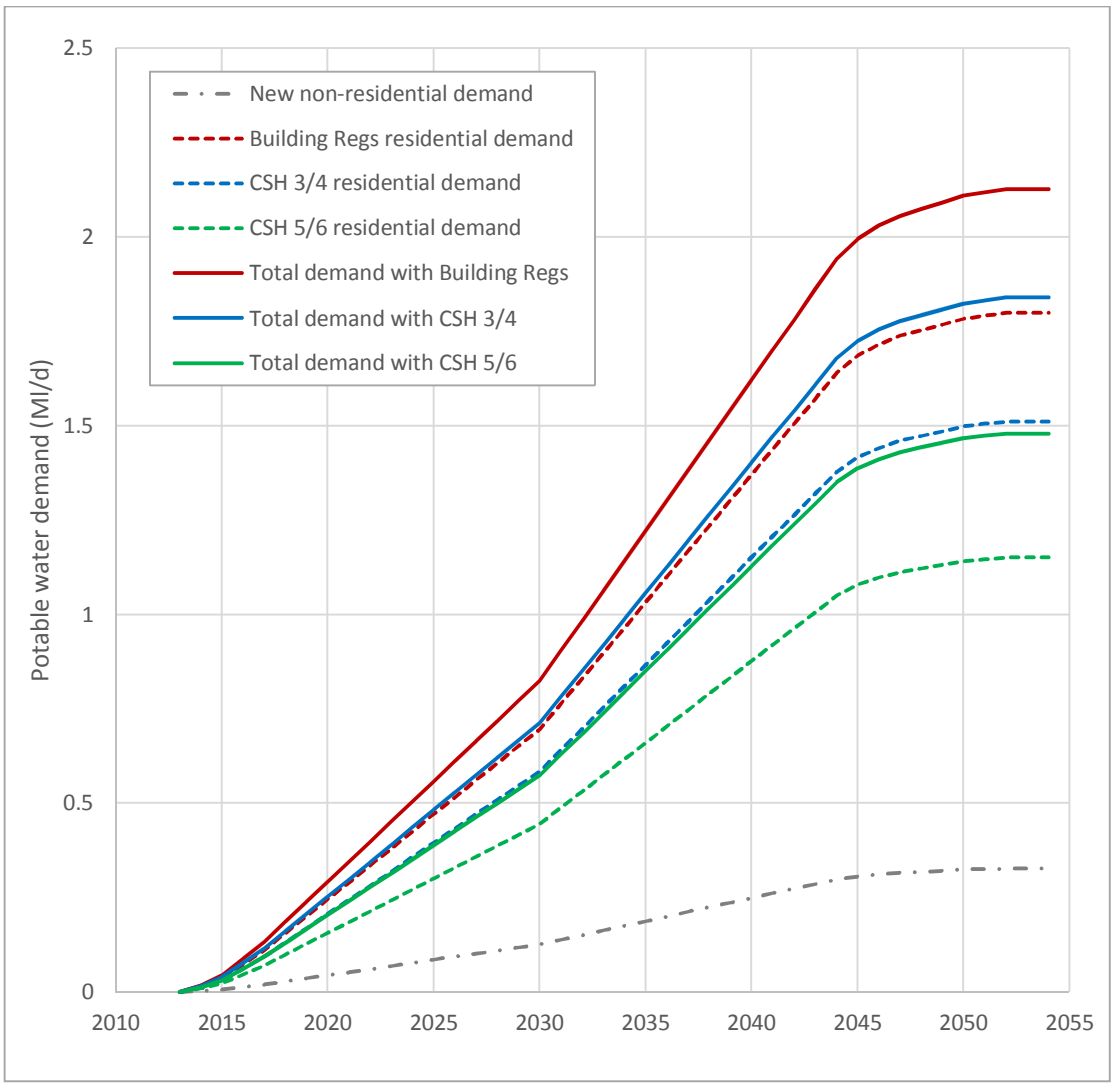


**Figure 5-5 New potable water demand for NW Bicester development**

The above figure highlights how the proposed policy to achieve a PCC rate of 80 l/p/d for residential properties significantly reduces the increase in net potable water demand, when compared against the Building Regulations PCC rates incorporated in to the TWUL WRMP.

## 5.4 Water efficiency measures

This Section explores how water efficient fixtures, fittings and behaviours may be utilised to achieve the PCC rates referred to above, and hence assist the development in aspiring towards water neutrality.

### 5.4.1 Residential water efficiency

To maintain consistency with Part G of the Building Regulations, the Building Research Establishment (BRE) CSH Water Efficiency Calculator Tool[12] was used to appraise the fittings and fixtures options for achieving, or bettering, the PCC rates for CSH Levels 3/4 and 5/6.

Using the BRE tool, it can be shown that the CSH Level 3/4 PCC target, (105 l/p/d) can realistically be met through the specification and installation of water efficient fixtures, including the following:

- 2.6/ 4.0 l dual flush toilet;
- 9 l/minute shower;
- 150 l bath;
- 6 l/minute taps;
- Conventional dishwasher and washing machine, assumed to use 4.5 and 17.16 l/p/d respectively; and

The above assumes that any water used external to the home (for car washing and garden watering - approximated at 5 l/p/d) is excluded from the total potable water demand. It is assumed that suitable measures will be incorporated in to the development's design to provide this water from a non-potable source, for example garden water butts.

The tool does allow for the specification of higher efficiency fixtures and fittings, however experience from similar WCS projects is that the above levels of efficiency should broadly be considered the limit that occupiers will find acceptable for the foreseeable future. Relying on additional demand reduction measures in the residential dwellings would increase the risk of occupiers replacing the efficient fittings in the future.

### 5.4.2 Non-residential water efficiency

Similar to the above, the incorporation of water efficient fixtures and fittings in to non-residential properties can significantly assist in moving towards the aspiration of water neutrality.

All new non-residential buildings in the development are aspiring to achieve an excellent rating under the Building Research Establishment Environmental Assessment Method (BREEAM).

BREEAM is an environmental assessment method and rating system which assesses the sustainability of building design, construction and operation, using a range of weighted criteria.[13]

Of these criteria, water efficiency is weighted to represent 6% of the overall rating. In order to achieve a rating of excellent, non-residential properties must achieve an overall rating of at least 70%. Whilst there are numerous routes to achieving this overall score by altering performance against all the criteria, it can be approximated that excellent, in terms of water efficiency, requires a score of 5 out of a possible 6 for this particular criteria.

This requires that the developer show that whole building potable water usage is reduced by at least 55% from the baseline condition. Whilst designs will vary for different building uses, BRE do offer some guidance as to the typical fittings, fixtures and approaches which would be required to achieve this rating.

These include:

- 2.6/ 4.0 l dual flush toilets;
- Dry urinal systems;
- Kitchen and bathroom taps limited to 5 l/minute and 3 l/minute respectively; and
- 3.5 l/minute showers.

Notably, BRE advise that developers should aim to use reclaimed surface water or wastewater to provide at least 75% of the non-potable water demand if they hope to achieve an excellent rating for this criteria.

Depending on the ratio of users to roof areas, and the ownership arrangements of the commercial properties, some non-residential areas will be strong candidates for using local RWH to provide this non-potable supply. However, this may not be practicable in all areas, hence some of these areas may require integration in to any greywater or wastewater effluent recovery systems serving the residential areas.

## 5.5 Water neutrality

Aspiring to water neutrality is a key theme of the proposed development.

Reducing the magnitude of the new demand from the existing water resources/ potable water infrastructure, and aspiring towards water neutrality, will typically require a mix of the following concepts:

- Increases in water use should be limited by reducing demand with water efficient fixtures, fittings and behaviours (as per Section 5.4);
- Components of water demand in both residential and non-residential properties which do not require potable water standards should be replaced with a suitable non-potable supply; and
- Opportunities to reclaim surface water run-off and wastewater from the new development should be explored, to provide either the non-potable supply described above, or a potable supply to supplement the existing network.

The extent to which water neutrality can be achieved can be measured by comparing the proposed new potable water demands with the baseline new potable water demands which would have resulted if the properties only achieved the PCC rates in line with the Building Regulations, expressed as a percentage.

Based on the calculations in Section 5.3, Table 5-6 illustrates the proportion of water neutrality which may be achieved if residential PCC rates are limited to 105 l/p/d and 80 l/p/d in keeping with the CSH Levels 3/4 and 5/6 respectively.

| | Building Regs | CSH 3/4 | CSH 5/6 |
|---|---|---|---|
| Non-residential demand (Ml/d) | 0.33 | 0.33 | 0.33 |
| Residential demand (Ml/d) | 1.80 | 1.51 | 1.15 |
| Total new demand (Ml/d) | 2.13 | 1.84 | 1.48 |
| Saving vs. Building Regs (Ml/d) | 0.00 | 0.29 | 0.65 |
| % water neutrality | **0.00%** | **13.53%** | **30.45%** |

**Table 5-6 Water neutrality comparison**

Table 5-7 illustrates the additional gain in terms of water neutrality which would be achieved if the 55% reduction in non-residential water use can be achieved in accordance with BREEAM.

| | Building Regs | CSH 3/4 | CSH 5/6 | CSH 5/6 with 55% reduction in non-residential demand |
|---|---|---|---|---|
| Non-residential demand (Ml/d) | 0.33 | 0.33 | 0.33 | **0.15** |
| Residential demand (Mld) | 1.80 | 1.51 | 1.15 | 1.15 |
| Total new demand (Ml/d) | 2.13 | 1.84 | 1.48 | 1.3 |
| Saving vs. Building Regs (Ml/d) | 0.00 | 0.29 | 0.65 | 0.83 |
| % water neutrality | **0.00%** | **13.53%** | **30.45%** | **38.93%** |

**Table 5-7 Water neutrality comparison (inc. BREEAM excellent for non-residential)**

In summary, the policies to limit PCC of potable water to 80 l/p/day in new residential properties, and reduce potable water demand in new non-residential buildings by 55% compared to the traditional baseline, result in the estimated potable water demand for the NW Bicester development reducing from 2.13 Ml/d to 1.3 Ml/d.

This should be considered a significant move towards the aspiration of water neutrality, as the net increase in demand for potable water will be nearly 39% less than if conventional PCC rates were realised.

In order to further close the 'water gap', and move the development further towards the aspiration of water neutrality, it is necessary to consider other changes to the water demand of the area brought about by the development.

As discussed in Section 3.1, it is unlikely that local groundwater or surface water abstractions would be suitable substitutes for supplies via the established TWUL network.

As highlighted in the Groundwater Supply: Feasibility Study, there is an existing licensed groundwater abstraction on site, for supplying drinking water to dairy cattle. If the development were to make the need for this abstraction redundant, then a further 48 $m^3$/day would be retained within the Great Oolite aquifer. If considered as part of the wider water neutrality calculations, this results in a total water neutrality value in excess of 41%.

Further increases in water neutrality would require the local reclamation of surface water, greywater or treated WwTW effluent to produce a potable supply to supplement or replace any bulk import of potable water from the existing TWUL network. Whilst such a closed loop system is appealing in terms of water neutrality, it includes a number of inherent risks which would likely make it unattractive to TWUL or any inset provider, including:

- Less opportunities to balance climate change and process risks, and resources, across a wider WRZ;
- The requirement to provide of a full scale back-up potable water supply to ensure statutory supply obligations can be met if the WwTW process malfunctions (maintaining drinking water quality in assets which are rarely used is problematic);
- The production of concentrated waste products which require tankering to other facilities for disposal*;

* Alternatively, this effluent could be further dewatered on site to produce sludge for use as an agricultural bio-solid. However, the technologies required to treat this high concentration effluent and produce a high quality bio-solid are only considered to be financially viable on the large scale.

- Emerging technological approach which will make securing funding and gaining Ofwat/ DWI approval problematic; and
- The potential for negative public and investor perception.

Given the above, and ongoing discussions with TWUL and potential inset providers, it is considered likely that any reclamation of surface water, greywater of treated WwTW effluent to achieve the required PCC rates < 80 l/p/day would be limited to the provision of a non-potable supply.

Community wide water efficiency retrofit initiatives may also be promoted by CDC and TWUL across Bicester. Therefore, there is opportunity for A2Dominion contributing to any such future CDC and TWUL potential initiatives if they are forthcoming as it will help further reducing the current water neutrality gap.

## 5.6 Non-potable supply options

For residential properties, at least 25 l/p/d of potable water demand must be replaced with non-potable water, to allow the target of 80 l/p/d to be achieved.

Assuming a dwelling is constructed with water efficient fittings and fixtures, the BRE tool estimates that 12.31 l/p/d is required for toilet flushing, and 15.62 l/p/d for use in washing machines. Therefore, if a non-potable water supply can be provided to supply 100% of these uses (totalling approximately 28 l/p/d), the potable water use of the dwellings will be approximately 77 l/p/d.

For non-residential properties, the proportion of non-potable demand is influence by employment density and building use. For example, office and retail developments have a relatively high non-potable demand, as the majority of their water use may be toilet flushing, whilst health care or hospitality developments require a higher proportion of potable water.

This Section illustrates the risks and opportunities associated with various options to provide a non-potable supply to the NW Bicester Development.

The following options for providing non-potable supply to the dwellings have been appraised by this WCS:

- Rainwater harvesting (RWH) at a property level;
- RWH at a wider neighbourhood level;
- Greywater recycling (GWR) at a property level;
- Greywater recycling at a wider neighbourhood level; and
- Local reclamation of treated wastewater.

The British Standard for RWH systems[14] confirms that potable water standards are not required for toilet flushing or washing machines, as these uses do not involve drinking, food preparation and cooking, dishwashing or personal hygiene.

### 5.6.1 Property level RWH

As illustrated in Figure 5-6, domestic level RWH would involve the installation of a rainwater tank for each property (preferably at basement level or buried in the garden) to collect filtered rainwater from the roof drainage.

Any additional rainwater would overflow from the RWH system for onwards transmission via the proposed surface water drainage infrastructure.

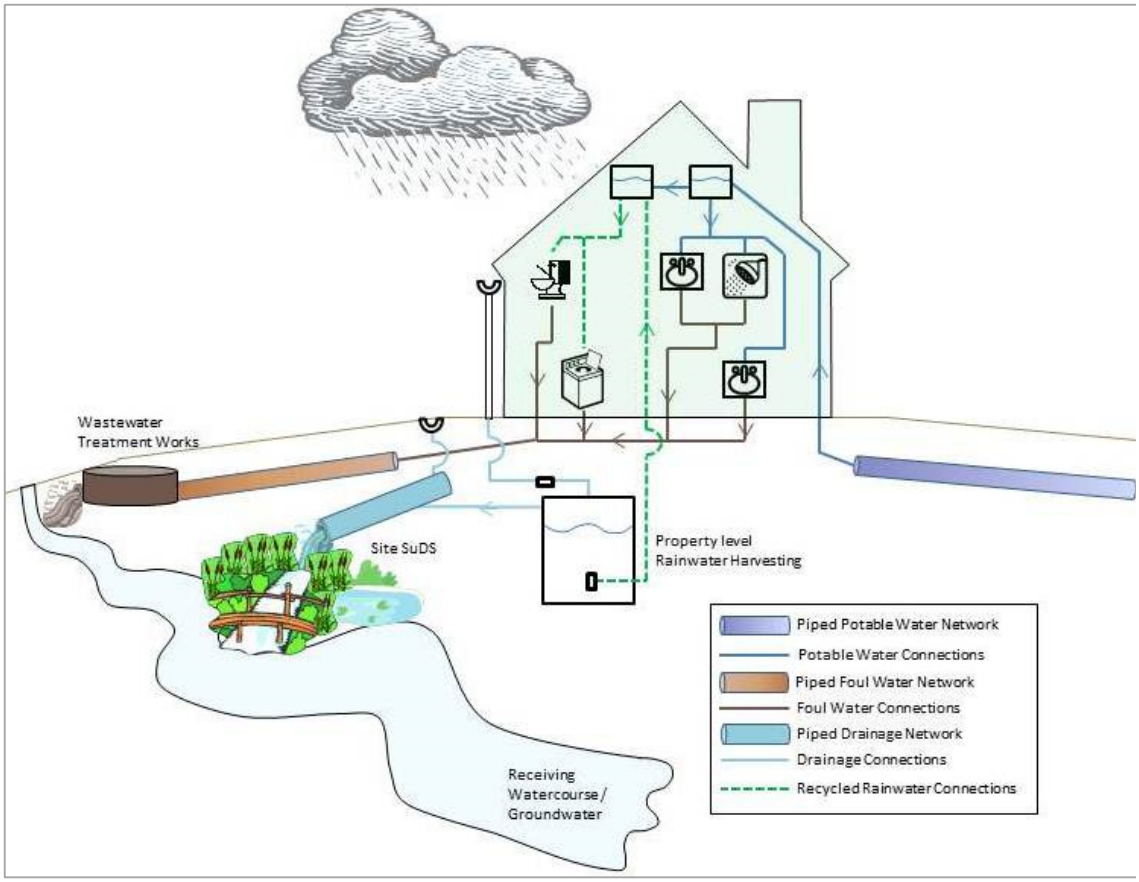


**Figure 5-6 Property level RWH schematic**

It is anticipated that the filtration would be in two stages; a 'first flush' system on the guttering downpipe to exclude any debris following a dry period, followed by a filter with a maximum particle size of < 1.25 mm prior to the inlet to the tank. BSI 8515:2009 states that such a filter provides suitable quality for toilet flushing and laundry in most residential situations.

This filtered and settled rainwater is then pumped from the tank back in to the house for use in the toilet and washing machine; hence requiring the inlets of these fittings to be connected to internal non-potable plumbing, separate to other potable water plumbing in the house.

The BRE tool calculates that a typical three bedroom house would be able to capture an average of nearly 90 l/day of rainwater from its roof*, equating to a non-potable supply of 30 l/p/d for non-potable use (with an assumed occupancy of 3), or 37 l/p/d (with an assumed occupancy of 2.4).

This suggests that under average conditions (and subject to adequate storage), a domestic level RWH system would be more than capable of supplying the non-potable demand for a house, allowing the 80 l/p/d target to be met.

* using BS8515 intermediate approach, with an assumption of 70 $m^2$ of roof area, a yield coefficient of 80%, a filter with an efficiency of 90% and rainfall of approximately 647 mm/year (Based on 1961-1990 Long Term Average data, DEFRA, 2008. These figures were compiled by the Centre for Ecology and Hydrology, Wallingford using data supplied by the National Climate Information Centre, Met Office).